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Railway Mechanical Engineer

Vol. 99 July, 1925 No. 7

The spray method of cleaning machinery

In many places, spray guns, similar to those used for painting, are now being used to supplant or supplement the work of the engine wiper and for cleaning all kinds of shop machinery. For cleaning electrical machinery, gasoline is sometimes used as the cleaning agent since it will remove the dirt without injury to the insulation. Probably the greatest objection to the use of gasoline is the fire hazard. Where injury to insulation is not a factor, the fire hazard is eliminated or at least greatly reduced by using an emulsion of water and gasoline. Dirt having a tar content will give way rapidly before a water and gasoline spray. For cleaning the running gear of locomotives, a mixture of water, kerosene and soap is used. The practice of cleaning machinery in this way results in the saving of much labor and in cleaning out-of-the-way places effectively. It will probably be used more widely in the near future and there remains the problem of determining the proper cleaning agent for each application. Different kinds of cleaners are needed and the proper one must be selected for each different application.

How about repair facilities?

Of all the subjects which are reported on by the various committees of the Mechanical Division of the American Railway Association, there is none which touches on a question of much greater importance than that on Locomotive Utilization. The last report of the joint committee and the discussion thereof at the June meeting of the Mechanical Division, an abstract of which will be found on another page in this issue, contains information which is well worth careful study. Operating statistics show that the railroads of this country have handled record-breaking traffic without suffering from a serious motive power shortage. This has been brought about to a great extent by a greater utilization of existing power. In this fact and in the aforementioned report lie a real message to the mechanical department officers, particularly those directly responsible for the operation of engine terminals. One of the big factors in the increased utilization of locomotives has been the extension of runs and the successful application of this operating principle depends upon several factors not the least of which is the maintenance problem. Increased locomotive mileage per day and between shoppings transfers a larger part of the burden of maintenance to the enginehouse repair forces, and because of this fact the master mechanic in charge must be fully alive to the added responsibility—of both organization and facilities. It is not a difficult matter for a wide-awake and progressive man to effect a reorganization of forces that will meet changed conditions. But, how about reorganizing facilities? If the reader happens to be in charge of an engine terminal which has already been, or is liable to be, affected by an operating charge which will tax the existing repair facilities to the utmost, may the suggestion be offered that it might be well to go back and read between the lines of the report and the discussion on "Locomotive Utilization." Therein may possibly be found just the point that is needed to clinch the argument as to why he should have some new machine tools or other facilities to replace those that have been handed down to him.

Effecting better brake performance

The Air Brake Association is an organization dealing with a highly specialized piece of railway equipment, concerning which few, except those who devote their entire time to the subject, can be more than casually informed. This has given the association a high measure of influence as well as a high measure of responsibility. It is interesting to note that during recent years there has been a well defined tendency on the part of this organization to take up actively those subjects bearing directly on the maintenance of air brake equipment in condition to perform its functions effectively and economically, and that in the handling of these subjects there is evident a thoroughness and scientific analysis which is worthy of the consideration of every other organization in the mechanical field. One of the first outstanding pieces of work of this kind was the study of the air consumption of locomotive auxiliary devices which brought to light the tremendous importance of establishing a high standard of maintenance for these pieces of apparatus in order to prevent them from robbing the air brake itself of an adequate supply of compressed air. Even a casual study of the proceedings of this year's convention, an account of which will be found elsewhere in this issue, will show that this association is tackling several problems of maintenance in a way which, when the work is done, will not only have established accurate methods of checking and well defined limits of wear, but will also have presented an array of evidence showing the necessity for the adoption of the standards recommended which will make it impossible for the railroads to ignore the recommendations.

A co-ordinator of departments

The outstanding impression left by the convention of the International Railway Fuel Association, a report of which will be found in this issue, is the wide range of subjects covered, on which papers were contributed by officers of several departments, and the wide range of departmental and group interests represented in the large attendance. The impression was strong that these men had come together not because of a narrow interest in the inside problems of

their own departments, but because of a broad interest in railroading and because of their appreciation of the tremendously important part that fuel plays in railroading. The value of this association, like that of many others in which mechanical department officers are interested, is measured only partially by the permanent value of the committee investigations or individual papers presented and discussed but lies also in the inspiration which comes from the group contact. The inspirational value of the International Railway Fuel Association conventions is particularly important because of the co-ordinating effect it produces in emphasizing the common interest of the various departments in producing a good job of railroading. The opportunity for this kind of co-ordination is undoubtedly greater in the case of this association than in the case of any of the other mechanical department organizations, because they are, by their very purpose, compelled to devote attention primarily to the technical problems of the motive power department or some of its branches. Is there not a possibility, however, for these organizations to get something of the inspiration which comes from a broadened viewpoint by devoting at least a small part of the time of the convention to the consideration of a message from a representative of one or more of the other departments? This is already being accomplished to a certain extent through addresses of executives at the various conventions, but it can be carried even farther to the consideration of papers dealing with some of the problems of common interest between the various departments, of which there are plenty from which to choose.

Wheel Committee favors grinding

With perhaps the prime object of bringing to wheel shop foremen, and particularly mechanics, information which will enable them to understand their work more fully and carry it out more intelligently, the Wheel Committee of the Mechanical Division this year submitted a proposed 100-page Manual on wheel shop practice which holds much of promise for a higher standard and decreased cost of this important work. Considerable space in the committee's report was also devoted to the subject of car wheel grinding, the conclusions strongly supporting contentions of the *Railway Mechanical Engineer* in the past in favor of this method of reclaiming car wheels with slid flat spots and thus at a small cost conditioning them for further service. Without encroaching too much on the findings of the committee, published elsewhere in this issue, it may be said that tests under actual shop conditions showed the average time of grinding a pair of cast iron wheels to be 30 min.; flat spots removed, 3¾ in. long; reduction in diameter on each wheel, ⅛ in.; and total cost, $1.19 per pair. This gave a saving per pair based on second-hand values of $5.31 and, based on new values, of $21.01, figures which indicate plainly the possibilities of economy by grinding slid flat car wheels. Moreover, the tests showed that new car wheels sometimes have a lack of rotundity of 1/32 in. or perhaps more and the treads are more or less rough due to chill marks, both of these conditions being readily overcome by grinding. A pair of new car wheels can be ground in 15 min. or less and assure smooth treads, concentric with the journals, on which there is less tendency for the brakes to stick. The importance of grinding from this point of view is indicated by the number of new car wheels on which the brakes stick and develop flat spots after very brief service. The committee's investigations also extended to the grinding of rolled steel wheels, and a comparison of the cost of turning in a lathe as opposed to grinding gave some highly interesting results. The report showed a reduction in diameter of 1/16 in. by grinding, whereas ⅛ in. was the smallest cut which the lathe tool could take and get under the hardened tread surface, making a total reduction in diameter of ¼ in. The resultant saving in service metal of 3/16 in. in favor of the grinding method was shown in the report to be worth $12.18 per pair of wheels. The important point in connection with car wheel grinding is apparently to select only those wheels in good condition except for the flat spots. Satisfactory results can hardly be expected with wheels already shelled, comby, badly thread-worn or flange-worn.

Why remove the stack?

While sometimes overlooked and seemingly forgotten, the plea for larger and better shop and enginehouse facilities to take care of modern power continues to be heard. In a paper read at the April meeting of the Western Railway Club, Chicago, A. G. Pack, chief inspector of the Bureau of Locomotive Inspection, Interstate Commerce Commission, said, "We find large modern motive power being maintained in the same old shops and with the same old tools that were provided years ago for the lighter equipment. Locomotives, shops and facilities should be modernized if the railroads are to keep abreast with the modern times and render the most efficient and economic service." Examples are not hard to find to substantiate Mr. Pack's statement. At one shop of some importance on a mid-west railroad it was observed that the smoke stack had been removed from one of the locomotives without any apparent cause. The stack seemed to be in good condition; there was no question of interference on the part of the stack which projected into the smoke box. The visitor had already noticed the entire absence of overhead crane facilities in this little old shop with its low roof-supporting timbers and this proved to be the cause of the stack removal. The master mechanic said in explanation, "I have to take the stack off in order to get the locomotive high enough to roll the wheels out from under her." This illustration tells its own story. Not only was there needless labor cost in removing and applying the stack, but the locomotive quite possibly was held in the shop longer than would otherwise have been necessary in order to reapply the stack. Moreover, the morale of the shopmen was bound to be adversely affected. What satisfactory argument or incentive could be offered to shopmen to increase their efficiency and productiveness when they saw wasteful practices permitted by the management of which the instance mentioned was simply an example. Small, poorly-equipped, antiquated and often dirty shops unavoidably mean excessive repair costs.

Mr. Pack also commented on the enginehouse situation as follows: "It is not uncommon to find boilers being washed and extensive repairs being made to locomotives and cars in the most inclement weather out of doors because the equipment has outgrown the housing facilities and in many instances where housing facilities have never been provided. In my opinion, making repairs under such conditions is false economy." Mr. Pack had previously commented favorably regarding the mechanical department officers of today, saying that on the whole they are equal if not superior in skill and ability to any ever employed by the railroads. They have not, however, always been given the support and recognition due them by those in authority. Is not one reason for this the fact that they

have allowed themselves to become so engrossed in the manifold and exacting duties of conducting mechanical department work that they have neglected to show the management just how much antiquated shops and worn-out tools are costing the railroads as compared to modern up-to-date equipment? In other words, have railroad mechanical departments obtained their just proportion of the money spent annually for additions and betterments? Have they not allowed some of this money to go to other departments of the railroads where it would save 10 per cent on the investment when perhaps a saving of 20 per cent could have been obtained by investing it in new shop tools and better facilities for maintaining cars and locomotives?

Interpretations of new Interchange Rule No. 44

The recognized weakness of many of the wood underframe cars, due to decay or other old defects combined with the questionable practice of keeping in service freight cars that are in an advanced state of deterioration, has embroiled the railroads in long and bitter disputes as to who is responsible for the failure of such cars under ordinary handling conditions. Under these conditions a car failure is unquestionably the owner's defect, but the Arbitration Committee of the Mechanical Division, when called on to make a final decision in such disputes is often prevented from correctly placing the responsibility for the damage owing to the impossibility of determining the actual circumstances under which the failure occurs. As a result of these conditions the handling line is often held responsible for damage to cars which should have been charged against the owner. Recognizing the fact that the handling line is entitled to a greater measure of protection than is afforded under the present rule, this year's report of the Arbitration Committee contains a new Rule 44, which definitely points out seven different classes of car failures under ordinary handling which require the handling line to furnish a statement, after a thorough investigation, in order definitely to establish the responsibility of the car owner for the repairs. The committee is to be commended for the inclusion of this new rule in its report as it will not only protect the handling line in the case of failures of badly deteriorated cars but will tend to reduce to a minimum the practice of keeping in service freight cars that are liable to failure under ordinary conditions.

The new rule also provides additional protection to car owners in cases where equipment, in good condition, is damaged in service but cannot be attributed to the provisions of Rule 32. The decisions of the Arbitration Committee have proved many times that it has been bound by the provisions of Rule 32 to charge the car owner with damage to cars which evidence undoubtedly indicated were damaged through too rough usage on the handling lines. Under the new rule if a car, in good condition, fails in any of the ways listed it will be a clear indication that the car has been subjected to unfair usage and the handling line should be held responsible regardless of the fact that the car was not derailed, cornered, side swiped or in a collision.

As a whole, the new rule provides protection for the handling line when passing over its road equipment in a decayed condition and also affords protection to the car owner against being held responsible for damage occurring to its equipment which is in good condition. It should do much to eliminate the constant controversy involved in the interpretation of Rule 32.

What Our Readers Think

Floating bushings have given good results

Greenville, Pa.

To the Editor:

In the April issue of the *Railway Mechanical Engineer*, S. J. Stark asks a question concerning floating main rod butt end and main connection side rod bushings. The following is an answer to his question.

With light locomotives having pins and bushings of small diameter and low tractive force, it often has been quite difficult to keep the main connection side rod bushing tight in the rod and in line with the grease hole below the grease cup. When the bushing keeper bolt was applied in the bottom of the rod it might become lost along the road, making it possible for the bushing to work loose and turn in the rod, thus blankig the grease holes and stopping lubrication, with a consequent hot pin and delay. This difficulty was overcome by drilling and tapping the

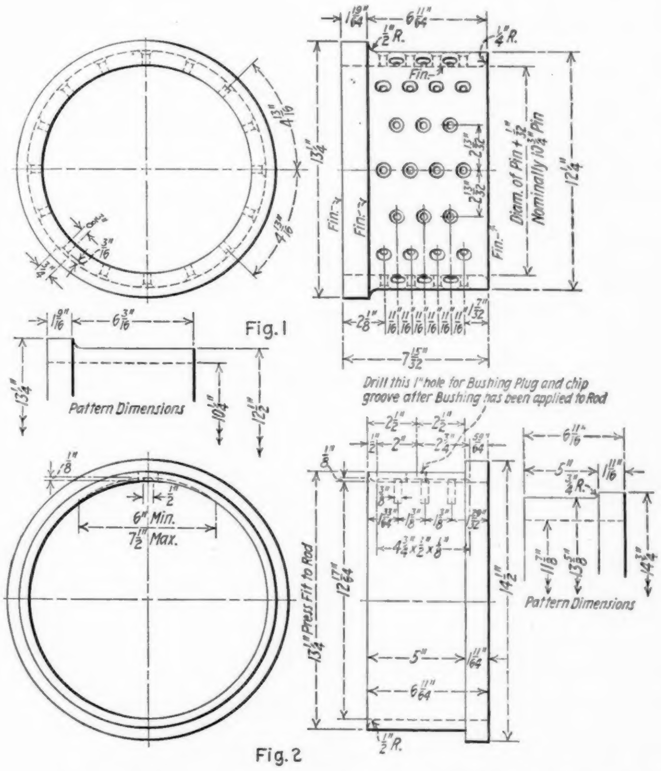


Fig. 1—Main side rod connection floating bushing
Fig. 2—The stationary bushing

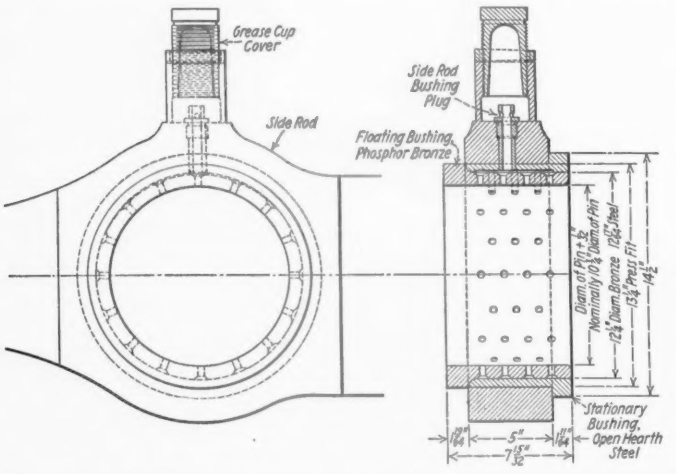
base of the grease cup to take a large diameter hollow bushing keeper. This method, however, produced new difficulties; such as the necessity of drilling out the keeper due to the twisting off of the small head, and on account of the small clearance in the grease cup it also was necessary to have a special wrench to remove the keeper. Even with this method when a large diameter bushing became heated and gripped the pin the leverage of the large diameter pin would shear the keeper at the edge of the hole in the bushing and allow the bushing to turn in the rod, which also shut off lubrication.

The logical conclusion then, since the bushing was

determined to turn, was to allow it to turn, and see that it received correct lubrication. Now, since the brass bushing was to turn in the rod, it would be illogical to allow the resultant wear to occur in the eye of the rod so it became necessary to provide a steel wearing surface by pressing a steel bushing into the rod under heavy pressure and then applying a keeper as a precautionary measure. In equipping existing power with floating bushings it was not considered advisable to increase the diameter of the eye of the rod. This necessitated the designing of the stationary and floating bushing, shown in Figs. 1 and 2, with a combined wall thickness equal to that of the original pressed bushing.

The first class of engines on this road to which experimental bushings were applied was a Santa Fe type having 30-in. by 32-in. cylinders developing a tractive force at 81,600 lb. The main side rod bearing was 10¾-in. inside diameter and the eye of the rod was 13¼-in. in diameter. It was decided to allow the stationary bushing to have ½-in. walls so as to make the wall thickness of the floating bushing of sufficient thickness to fill the remaining space around the pin.

The first experimental bronze floating bushing had two outside circumferential rows with 20 grease holes per row, ¼-in. in diameter, spaced 1⅞-in. on the outside



Drawing showing the arrangement of the main side rod bushing

circumference, staggered and connected inside and outside with zig zag grease grooves. One center circumferential row contained 10¼-in. diameter grease holes. The center circumferential row and zig zag grease grooves were connected on the outside face of the bushing by a machined circumferential groove ½-in. wide and 3/16-in. deep. Operation under service conditions showed that these zig zag grooves provided an easy breaking point for the bushing.

It next was decided to experiment with several parallel circumferential rows of ⅜-in. diameter holes, staggered and countersunk on the outside face of the bushing. Four types of bushings were designed, all having the same wall thickness and the same number of circumferential rows, but having a different number of holes and indicated in the table below.

Style	No. of holes	
1	180	without collar
2	140	with collar
3	72	without collar
4	56	with collar

In order to make a comparative test, several locomotives of the same class were equipped with one type of bushing on the right pin and another type on the left pin. On some engines a similar comparative test, between a new style floating bushing and an old style pressed stationary bushing, was made. After the test in actual service had lasted one year, the following average mileage was shown for the various types of bushings:

Old style pressed bushing	14,000 miles
Zig zag grease grooves with 50 holes	24,902 miles
Style 1	23,565 miles
Style 2	20,041 miles
Style 3	25,158 miles
Style 4	28,640 miles

No further attempt was made to reduce the number of lubricating holes. The floating bushing shown in Figs. 1 and 2 was adopted as standard for this class of locomotives. This bushing had shown an average of 28,640 miles in service, required less machine work, was lubricating properly and was in the best condition at the end of the test. These floating bushings now replace an old style bronze bushing which consisted of a phosphor bronze bearing surface cast inside a gray iron ring.

Material for the old style bushing cost $27.50 while the material for the new combined stationary and floating bushing cost $37.30, an increase of $9.80 or 35 per cent. The machining cost of the new arrangement over the old showed a further increase of 100 per cent for new installations, but this increased cost amounts to only about 25 per cent on bushings applied after the steel bushing is in place. However, to offset these increased first costs we have double the service miles and a greater ease of maintenance in the enginehouse, for with the floating bushing it is not necessary to remove the side rod in order to remove and replace a worn or broken bushing. The saving in enginehouse stall space, labor of replacement, and locomotive service hours more than offsets the additional machining expense.

A clearance between the friction faces of the stationary and floating bushings of 1/64-in. is considered sufficient on lighter power, but on the heavier classes of engines this should be slightly increased, for on these engines the floating bushing with close clearance sometimes heats and binds in the stationary bushing. With an increased clearance the rubbing surfaces remain bright and clear, the bushing rotates easily, and may be removed readily by the enginehouse forces.

From the experience gained from these experiments it was decided to allow just sufficient lubricating holes in future installations, on other classes of power, so that each hole would lubricate approximately 4.35 sq. in. of area on the outside circumference of the floating bushing.

G. Charles Hoey.

Another question about floating bushings

Toledo, Ohio.

To the Editor:

I am writing for information in regards to floating bushings on the back end of main rods. Are they used on switch engines? What method is used to shorten the main rods on this type of locomotive when it is necessary to adjust the length on account of setting up and lining driving box wedges and keying up the front end main rod brasses.

The total piston clearance on most engines is 9/16 in. which leaves 5/16 in. front cylinder head clearance. I find that with solid type back end main rods, on account of both the front and butt end wedges lengthening the rod, it is necessary to watch the clearance closely. This is the reason I would like to know what method is used in keeping the proper clearance with floating bushings.

Sidney H. Kohler,
Shop foreman, Toledo Terminal.

Meeting of A. R. A. Mechanical Division at Chicago

Important reports on locomotive design and construction, design of shops and engine terminals, and car construction

THE 1925 annual meeting of the Mechanical Division, American Railway Association, was held at the Drake Hotel, Chicago, Tuesday, Wednesday and Thursday, June 16, 17 and 18, 1925.

The meetings were called to order at 10 A. M. each morning by J. J. Tatum, general superintendent car department, Baltimore & Ohio, chairman of the Division. The Tuesday session was opened with an invocation by the Rev. Scott R. Hyde, Chicago. This was followed by an address by R. H. Aishton, president of the American Railway Association, and by Chairman Tatum's address, abstracts of which follow:

Chairman Tatum's address

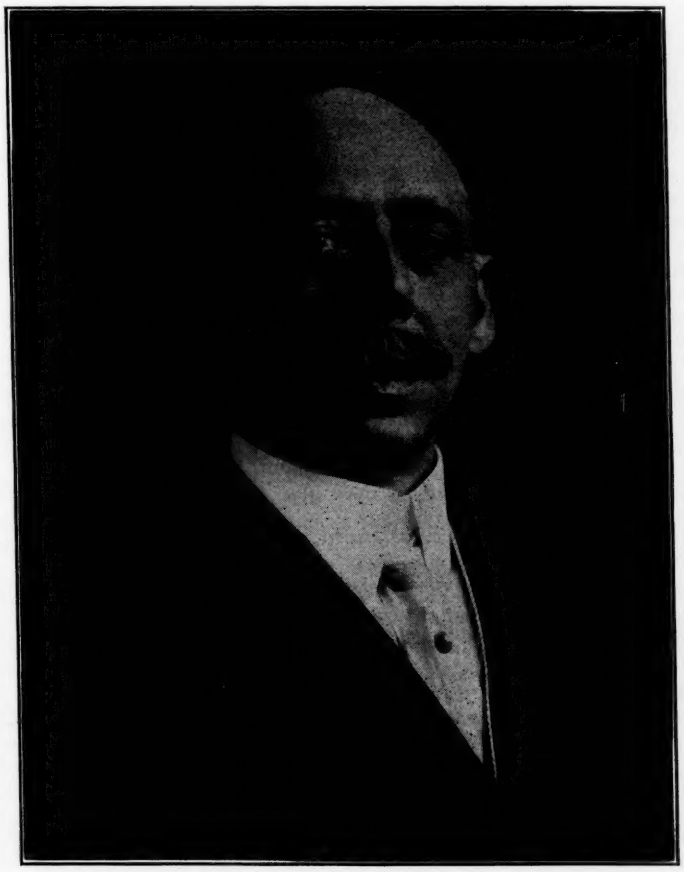
The following is an abstract of Chairman Tatum's address:

The importance of these Mechanical Division conventions cannot be measured and should not be underrated. We should consider the responsibilities resting upon us as members of this great Association.

The proper management of railroad properties affects the investments of over two million stockholders, the greater proportion of them small investors, many of them fellow railroad workers. Railroad securities to the extent of approximately two billion dollars are owned by insurance companies, representing over forty million people. The banks of this nation are holding the savings of its patrons to the extent of seventeen billion dollars, over one billion of which is invested in railroad securities.

To point out further the immensity of our obligations, the statistics of the Labor Board show there are employed in the maintenance of equipment department of all Class I railroads in the United States, as of February 1, 1925, 541,057 employees. In 1924 the expenditures of the maintenance of equipment department of Class I railroads represented $1,270,119,592, or 21.22 per cent of the total operating revenue of $5,986,492,120. In addition to this we are responsible for many of the designs and standards of new locomotive and car equipment on which there is expended yearly many millions of dollars for its purchase.

Our railroads in the past 100 years have been of unparalleled importance in the growth of the United States, when it is considered that during the same period the population of this country has expanded from ten millions to one hundred and ten millions. The wealth of this nation one hundred years ago was less than three billion dollars; today, it is over three hundred billions.



J. J. Tatum
Chairman, Mechanical Division, American Railway Association

Never was there a greater opportunity for the further development of this nation than we have today. Never were the opportunities greater for intelligent, level-headed, hard-working men of high character. Their efforts to manage wisely the accumulated machinery and wealth will not only reflect upon themselves and their dependents, but upon the nation as a whole.

In my opinion the management and economical operation of railroads will depend very materially on the establishment of better understanding and relationship between the public, railroad managements and the workmen. This, I think, can be best brought about by co-operation between the railroad managements and their employees. We must endeavor to understand the employee's side of his relationship with the company as we would have him understand the management's side. As managers we should put ourselves in the workman's place in reasoning out the differences that may exist between us from time to time.

The railroads must be kept in uninterrupted operation. They must provide the service required at all times. This can be accomplished with the peace and good-will of our employees, which is assured when we are willing to co-operate with them and they are willing to co-operate with us. Perhaps the greatest and most effective co-operation can be obtained by having employees become interested in railroad properties to the extent of becoming owners of their stocks. When financially involved we are more conservative in our actions and more interested in the final results than when not so involved. Therefore, if all the employees of railroads were stockholders to a more or less extent there would be a greater assurance of peace and co-operation.

One of the most outstanding reports this year is that of the Committee on Car Construction; the designing of the double-sheathed box car, and the work of the special sub-committee of the Committee on Car Construction in preparing a manual of fundamentals for car design. Another important work was that of the Committee on Wheels. This year they have prepared a manual of wheel shop practices including description of all the different kinds of wheel defects, etc., which they will present.

At the last convention it was thought that we would adopt as recommended practice the all-steel double-sheathed box car. This, however, apparently did not meet with the approval of sufficient members of the association to make this possible. I am pleased to advise, however, notwithstanding the fact that this design of car has not been approved as yet for recommended practice, the Pennsylvania has built 22,000; the Baltimore & Ohio, 2,000; the Read-

ing, 1,000; the Wheeling & Lake Erie, 1,000; the Norfolk & Western, 1,000. and the New York Central, 100—a total of 27,100 cars.

The A. R. A. single-sheathed box car has been approved as recommended practice, and to date I understand the Louisville & Nashville has built 2,500 of these cars; the Southern Pacific, 2,000; and the Missouri Pacific, 2,000—or a total of 6,500 cars. There may be more of which we have no information.

The association approved and has built two double-sheathed wooden box cars, which have been designed during the current year by the Committee on Car Construction.

The most of the work of the association is necessarily borne by a comparatively small number of its members. We need assistance in our annual meetings, conferences and committee work, and I ask that you all contribute a part.

Address of President Aishton

I want to take the opportunity to thank heartily the Mechanical Division, its various chairmen of the General Committee, its present General Committee, the various committees, and the individuals that operate these railroads for what they have done to bring about that result.

Transportation today is adequate. It is reflected in the report I saw in the morning papers from our office at Washington. Take the week before last, which is the last report we have. The railroads of this country loaded and moved 994,874 carloads of freight. Two years ago when we set 1,000,000 cars as the mark, it was the top notch of transportation in this country, and yet week before last, you moved within 5,000 cars of that number at an off season of the year when transportation is not by any means at its maximum, with 300,000 surplus cars and about 7,000 surplus locomotives ready for business when the fall movement comes.

Now, I am no prophet, but I feel confident that no matter what load of transportation is offered to these railways this autumn or in succeeding autumns, there never again is going to be in these United States or in Canada any question as to the ability of the railroads to furnish adequate, prompt, and proper transportation for whatever may be offered. We have made some estimates, and I would not be surprised this fall to see all previous marks surpassed.

There has been a change in the commodities that are being handled. There has also been a change in the distances they have been hauled. The furnishing of adequate transportation has brought about a profound change in the industrial relations of this country. Where it used to be that a man would figure on delays in transportation and stock up for weeks and months in advance, today dealers and shippers are purchasing on the basis of adequate transportation. Adequate transportation has brought about another result, and that is in the amount of capital tied up in goods in transit. The shortening of the time that goods are in the hands of the railroads has brought about very much lower rates on capital and is one of the prime reasons why today money is cheap in this country.

I had a shining example of that just the other day. A man came in to see me, and said, "I don't hand the railroads a bouquet very often, but I think it is due them that I tell you." His company ships ore from Butte, Montana, and Bisbee, Arizona, down on the eastern seaboard. He said, "We recently had to ship a lot of concentrated copper ore down there by rail. We kept an accurate tab on about 500 carloads, and it was on the road only thirteen days." He said, and this is the significant thing, "It has entirely revolutionized our way of doing business. We used to keep big stock piles. Today we are making our shipments according to our daily requirements with the absolute knowledge that that material will be delivered to us as it is needed. The saving we make on interest charges on that copper ore, which is very valuable, alone goes a material way toward paying the freight charges."

There is another side, however, that is not so satisfactory. The work your Division, all the other Divisions of the Association and the individual railroads are doing has been and should continue to be to produce the largest economies that are possible in the operation of these railroads. In other words, keep your eyes and ears open. If you see or hear of a better way of doing a thing, go after it, because one of the great question in the public mind today, and that will be prominent at the national capital in the next year or year and a half, particularly in connection with the investigation into the question of freight rates, their relation to each other, and their adequacy to produce revenue to attract capital, is the economies and efficiencies in the operation of these railroads. You cannot do any greater work than to put in the hands of your representatives who will have to put their case thoroughly before the people and answer that question, the answer as to whether you, as an organization, and your individual railroads are taking advantage of every known thing that is humanly possible to bring about greater economies.

This is the fifty-eighth annual meeting of the Master Car Builders' Association and the Master Mechanics' Association, and their successor, the Mechanical Division of the American Railway Association. In that 58 years your record has been one of continual accomplishment along lines of economy, safety and efficiency. In 1882 there were 56 different kinds of axles in the equipment of the railroads of this country. Today you have one type with six sizes. That of itself is a tremendous accomplishment. In 1882 there were 58 kinds of journal boxes. At the present time you have only one kind with six sizes. There were 26 kinds of couplers. At the present time you have only one. There were 20 different kinds of brake shoes used on freight cars. At the present time there is only one. In 1882 there were 27 different kinds of brake heads. At the present time there is only one kind.

These are some of the things you have accomplished in simplification and standardization that in the end have brought about the ability of these railroads to move freight at a rate per thousand ton miles materially less than that afforded by any transportation by railroad in the world. I am not going into details as to the other things you have done. What I have recited about these various parts of freight cars is an indication of what has been done in every direction.

Take the specifications for materials. Take this standard car that we have had so much discussion about, and about which some of you have felt disappointment because we have not moved faster. I believe that safety in getting the real answer to that matter lies in the fact that you have not moved faster. That is indicated by the standards that you have already prepared and approved in this Division, and which today are very largely governing the building of new freight equipment.

It is my prediction that the next two or three years are going to see a standard car perfected that in its main requirements as to dimensions is going to govern the building of 90 per cent of the equipment in this country. While your accomplishments in the past have been great, there has been no time when such constructive progress has been made in the work of this Division as in the last two or three years.

You are studying a lot of things which some of you think the American Railway Association ought not to consider. But just consider that there are a lot of people, not railroad people, who get these ideas and somebody has to have the answer for them. Who better can find the proper answer for us than you gentlemen who have spent all your lives in the development of this mechanical machine on the railroad?

You made a splendid showing this last year, with $80,000,000 less expense for maintenance of equipment. Quite a part of that is due to the very large amount of new equipment and the vast capital expenditures made by these railroads. I notice that the railroads last year expended $104,682,000 in new shops, improved shops and improved facilities, to reduce the cost of operation.

That brings us to the point that I have already mentioned that, while the service was adequate, there was one side of the question that was not satisfactory. It has been determined by Congress through the Transportation Act that the railroads are entitled to a reasonable return on the capital invested providing the operation is conducted in an efficient and economical manner. The return in no year since the railroads came from Federal control has reached the amount set under the law by the Interstate Commerce Commission as a fair and reasonable return. That rate today is 5¾ per cent. In the year 1923 the railroads were $99,000,000 short of what is a reasonable return on the capital, as indicated by the tentative valuation as prescribed by the Commission, which is not the value as claimed by the railroads. Last year it was $148,000,000 that they were shy, and in the first three months of this year they were still short $21,000,000 of that reasonable return.

Now, of course, the railroads of the country cannot go on spending money, investing capital indefinitely, unless they receive a fair return—such a return as will attract capital, which in turn will provide more economical and more adequate transportation.

So there never was a time when the work of this Division was any more important to the railroads than the present time, for the

next year or two concentrating on those things which will bring about economies and at the same time maintain the efficiency which you have maintained in the last two or three years.

Outside of the matter of economy there is another important thing you want to keep in mind. We heard a great deal for a number of years about the lack of opportunity for management; that governmental activities were taking the place of individual management. I am not at all sure that in some ways possibly we were not a little at fault in not taking the initiative, and that this lack of initiative on our part encouraged action through some arm of the government that felt it must take the initiative. The government does not want to get into the game, but to prevent their getting into the game you gentlemen have got to function. You have been functioning, and today you have got a standing established with the officers of the government such as you never had in your history. And as long as we keep that way there won't be very much question about the government interfering with your management.

Today, as at no other time, when any question arises in regard to something on the railroads one of the first steps taken is to communicate with your chairman. If they can't get him they get me, and I communicate with Mr. Tatum, or whoever may be chairman.

I love the government. Our government is the greatest government in the world, but I love it best when it is not undertaking to manage the railroad business and I am going to try to keep it from doing so if I can.

Report of the General Committee

The report of the General Committee states that the membership of the division at the present time includes 208 railways, representing 399 memberships in the American Railway Association, and in addition thereto, 190 railroads, associate members of the American Railway Association. These railroads, members and associate members of the American Railway Association, have appointed 999 representatives in the Mechanical Division. In addition, there are 1,065 affiliated members and 142 life members.

In addition to a number of routine matters which are formally mentioned in the report, it calls attention to the work of the Director of Research in charge of the investigation of power brakes and power brake systems, through whom arrangements have been made for complete tests of the various brake equipments offered, on the test rack of the association at Purdue University. Attention is also called to the fact that on a recommendation from the Committee on Couplers and Draft Gear an appropriation for $50,000 has been granted to construct a draft gear testing machine upon which tests of draft gears will be made under the auspices of the association with a view to developing a specification for draft gears.

Life members

The report also contained the following list of members who have been made life members during the past year:

Date joined	Name	Title and railroad
1905	Barclay, F. B.	S. M. P., Illinois Central.
1905	Chidley, Jos.	S. M. P., New York Central.
1905	Deeter, D. H.	M. M., Reading Company.
1905	Dickson, J. G.	S. M. P., Spokane, Portland & Seattle.
1905	Dinan, Arthur	Amarillo, Texas.
1905	Downing, I. S.	G. M. C. B., C. C. C. & St. L.
1905	Eberle, Wm. F.	General foreman, Pennsylvania.
1905	Ferguson, L. B.	S. M. P., Alabama & Vicksburg.
1905	McGoff, J. H.	Mech. supt., A. T. & S. F.
1905	Meister, C. L.	Mech, eng., Atlantic Coast Line.
1905	Mullen, D. J.	S. M. P., C. C. C. & St. Louis.
1905	Robider, W. J.	Fibreboard Co., New York City.
1905	Temple, C. H.	Chief of M. P. and R. S., Canadian Pacific.
1905	Wahlen, John	Superintendent,Springfield Electric Railroad.

Obituaries

Following is a list of the members of whose deaths the secretary has been advised, which was also included in the report of the General Committee:

Name	Title and railroad	Died
Banks, O. L.	Superintendnt, Pullman Company	Apr. 23, 1924
Gallagher, F. S.	Eng., Rolling stock, New York Central	Oct. 26, 1924
Garstang, Wm.	Indianapolis, Ind.	Sept. 12, 1924
Haig, M. H.	M. M., A. T. & S. F.	Nov. 10, 1924
Holder, J. A.	Gen. M. B. M., Seaboard Air Line	Apr. 1, 1925
Howard, J.	S. M. P., New York Central	Mar. 24, 1925
Iffla, A. H.	Asst, loco. supt., United Rys. of Havana	Aug. —, 1921
James, Ed. T.	34 W. Broadway, Mauch Chunk, Pa.	Nov. 3, 1923
Jaynes, R. T.	M. M., Lehigh & Hudson River	
Kalbaugh, I. N.	S. M. P., Coal & Coke	Oct. 13, 1920
Kent, F. S.	G. C. I., Pennsylvania	Jan. 19, 1925
Kileen, G. C.	Gen. supt., So. N. Y. Power & Ry. Corp.	Sept. 21, 1921
Lewis, W. H.	Roanoke, Va	June 4, 1924
Linstrom, C. A.	Chief Engr., P. A. & Mck. R.	Sept. 2, 1921
Littell, C. N.	St. Louis, Mo	Sept. 17, 1924
Lord, Alfred W.	S. M. P., Quincy & Torch Lake	Sept. 15, 1920
Lynn, W. K.	Supt., Gulf & Ship Island	
McBride, B.	M. M., Southern	
Meloy, H. C.	Supt., Elec. Appl., New York Central	Oct. 13, 1921
Moir, G. M.	Asst. Supt. Equip., U. S. Railroad Adm'n.	
Monahan, F. J.	D. M. M., Louisville & Nashville	May 20, 1924
Porth, H. W. L.	M. C. B., Swift Refr. Transit Co.	Mar. 2, 1925
Rae, Clark H.	Asst. Supt. Machy., Louisville & Nashville	Dec. 8, 1923
Randolph, L. S.	Baltimore, Md	Mar. 7, 1922
Reid, Chas. H.	Loco. Engr., N. Y. N. H. & H.	1924
Rogers, W. A.	Supt. Shops, Southern Pacific	Mar. 18, 1925
Sheer, J. M.	East St. Louis, Ill	1922
Sinnott, W.	M. M., Baltimore & Ohio	Jan. 1, 1922
Smith, J. L.	S. M. P. & E., Pitts., Shawmut & Northern	Apr. 15, 1924
Smith, W. A.	Chicago, Ill	
Smith, W. G.	Denver, Colo.	Nov. 3, 1921
Snodgrass, W. C.	Pres., Blakely Southern Railroad	
Thayer, F. C.	G. R. F. E.. Southern	Nov. 12, 1924
Thiele, C. F.	C. C. I., Pennsylvania	Apr. 27, 1923
Thomas, R. V.	Supt. Machy., De Queen & Eastern	
Thomas, W. H.	Philadelphia, Pa	Mar. 7, 1914
Walton, E. A.	Franklin, Mass.	June 27, 1922
Weir, Robt.	M. M., E., D. & B. C.	
Westervelt, Jos.	M. C. B., New York Central	
Wightman, D. A.	Warren, R. I.	July 6, 1917
Williams, C. R.	Corning Machine Co.	May 27, 1918
Williams, W. H.	Gen. For., Erie	Mar. 1, 1924
Witt, G.	Lambert Bros. & Wirt	Nov. 6, 1924
Witt, J. G.	M. M., Washington, Idaho & Montana	June, 1923
Woodcock, C. A.	M. M., Caguas Tramway	

The report of the committee was signed by J. J. Tatum (chairman), superintendent car department, B. & O.; J. T. Wallis (vice-chairman), chief motive power, Pennsylvania System; C. F. Giles, superintendent machinery, L. & N.; A. Kearney, superintendent motive power, N. & W.; L. K. Sillcox, general superintendent motive power, C. M. & St. P.; J. Purcell, assistant to vice-president, A. T. & S. F.; C. E. Chambers, superintendent motive power and equipment, Central of New Jersey; C. H. Temple, chief motive power and rolling stock, Canadian Pacific; G. E. Smart, chief car equipment, Canadian National; J. S. Lentz, master car builder, Lehigh Valley; W. J. Tollerton, general superintendent motive power, C. R. I. & P.; J. A. Power, superintendent motive power and machinery, Southern Pacific Lines; O. S. Jackson, superintendent motive power and machinery, Union Pacific; F. H. Hardin, chief engineer motive power and rolling stock, New York Central; W. H. Fetner, chief mechanical officer, Missouri Pacific, and A. R. Ayers, assistant general manager, N. Y. C. & St. L.

Officers elected for the coming year

In electing the officers and members of the General Committee this year, the Rules of Order were suspended and the secretary instructed to cast the ballot of the convention for the candidates proposed by the Nominating Committee. Those elected were as follows:

For Chairman—Term expiring June, 1926:

J. T. Wallis, chief motive power, Pennsylvania System.

For Vice-Chairman—Term expiring June, 1926:

L. K. Sillcox, general superintendent motive power, Chicago, Milwaukee & St. Paul.

For the General Committee—Term expiring June, 1927:

A. R. Ayers, assistant general manager, N. Y. C. & St. L.

W. H. Fetner, chief mechanical officer, Missouri Pacific.

F. H. Hardin, chief engineer, motive power and rolling stock, New York Central.

O. S. Jackson, superintendent motive power and machinery, Union Pacific.

J. S. Lentz, master car builder, Lehigh Valley.

J. A. Power, superintendent motive power and machinery, Southern Pacific Lines in Texas and Louisiana.

W. J. Tollerton, general superintendent motive power, Chicago, Rock Island & Pacific.

To succeed unexpired term of L. K. Sillcox—Term expiring June, 1926:

J. J. Tatum, superintendent car department, Baltimore & Ohio.

The members of the Nominating Committee whose slate was elected are F. W. Brazier (chairman), assistant to general super-

intendent rolling stock, New York Central; H. T. Bentley, general superintendent motive power and machinery, Chicago & North Western; J. J. Hennessey, assistant master car builder, Chicago, Milwaukee & St. Paul; C. E. Chambers, superintendent motive power and equipment, Central of New Jersey; and W. J. Tollerton, general superintendent motive power, Chicago, Rock Island & Pacific.

Report on the design of shops and engine termnials

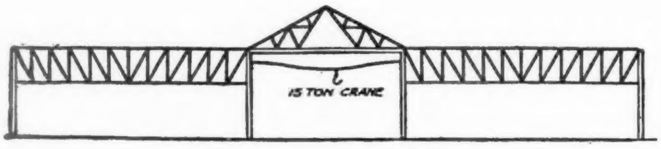
The following report constitutes a study of the design and layout of passenger car repair shops and is presented in response to may recent inquiries to the committee handling this subject for information regarding modern layouts of plants of this nature.

Within the last few years, in all manufacturing plants, much attention has been directed to the routing of the article being manufactured through the various stages and operations necessary to produce the finished article. It has been found that by routing, production is increased and as a result the cost per unit of output is correspondingly decreased. This is the result of:

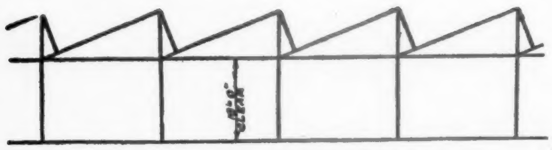
1. Having definite operations for each workman.
2. Reducing waste time of workmen unnecessarily traveling about the shop.
3. Having definite locations for laying down material near the workmen.
4. Moving material by the shortest routes.

The routing systems have perhaps reached their greatest development in the automobile industry. Apparently railway repair shops, in general, have been the last to take up any such system. This is due, perhaps, both to the difficulty of applying such systems to the work of repairing railway equipment, and to the arrangement of most railway plants which are not of recent construction and do not lend themselves easily to routing systems. Even in the more modern shops it does not seem possible to apply a routing system to all classes of repairs. Within recent years, however, the so-called progressive system of freight car repairs has been installed in a number of shops and excellent results have been reported. In canvassing among a number of car shop supervisors it was found that it is almost a unanimous opinion that a modern passenger car repair plant should be designed along the lines of the progressive repair system.

However, in any plan of passenger car shop the progressive system as applied to freight car plants is not equally applicable to passenger car shops, for the reason that it is not convenient to move passenger cars from position to position as is done with freight cars. Nevertheless, it does seem possible to route materials and parts to be repaired from and to passenger cars so as to minimize labor.



SECTION OF REPAIR SHOP



SECTION OF PAINT SHOP

Plan No. 1—A passenger and freight car

In all layouts it is assumed that the cars going into the repair plants will pass in front of or near the electrical shop, plating shop, upholstering shop, and tin shop, and that, when it is most convenient, there will be removed from the cars: the batteries and electrical equipment, plated fixtures, upholstering, water coolers, etc., and these will be sent to the respective shops for repairing. The cars are then moved to the scrub room for interior cleaning. Here the sash, doors, deck screens, etc., are removed and sent to the varnish room for refinishing or, if necessary, to the cabinet shop for repairs. The chairs, tables, and other furniture are handled in the same manner. The cars then proceed to the paint shop or the sand blast building to have the paint removed by burning, or by sand blasting after which they go to the repair shop where all defective parts are repaired.

Upon coming out of the repair shop the cars are passed to the paint shop for refinishing and replacing of sash, doors, furniture, etc., and then move out on a track which is near the track on which they first entered the shop. Here the batteries, upholstering, plated ware, tin ware, etc., are replaced.

Coach repair shop

Coach repair shops are practically all of the transverse track type. The longitudinal track shop can not be used to advantage in repairing passenger train cars. Each transverse track has length sufficient for one or two cars with ample space between them for repairing the ends of the cars.

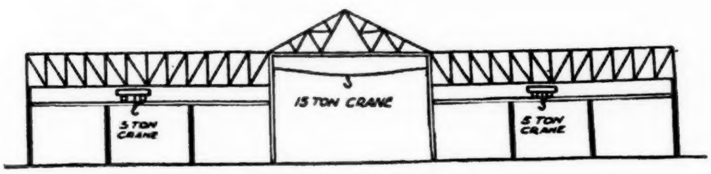
In width the coach repair shop should not be less than the length of the longest coach on the road plus the length of each of the trucks, plus at least a 10-ft. aisle next to the wall and a like aisle between cars in a two car track shop. This will mean a width for a single car track shop of 110 ft. to 150 ft., and for a two car track shop of 220 ft. to 270 ft. The width may be decreased correspondingly if the trucks are not taken into the repair shop, but instead are removed from the cars at a stationary jack on the inbound track. The repair tracks should be spaced at least 24 ft, center to center.

The height from the floor to the bottom chord of the roof trusses should not be less than 22 ft.

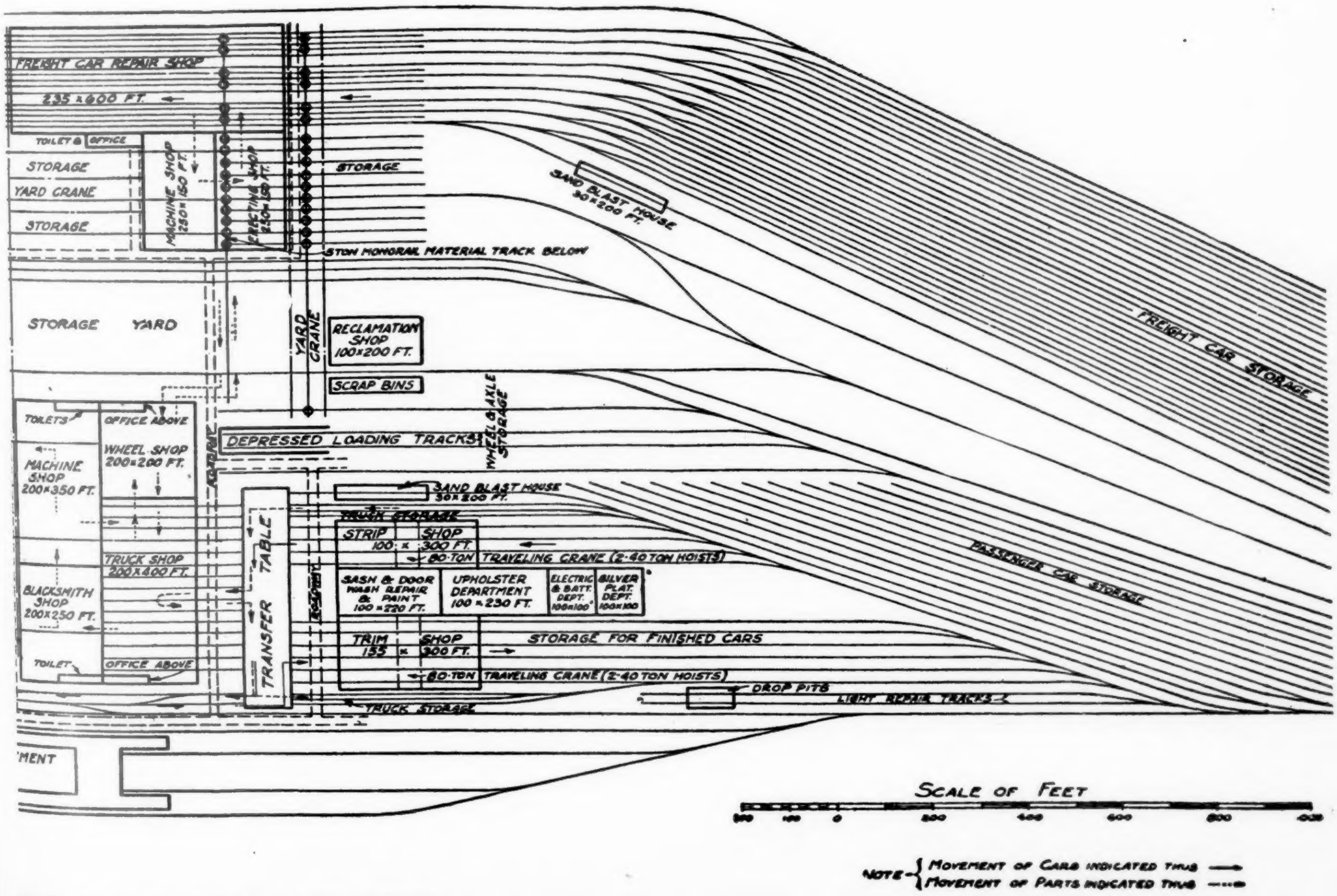
The shop should be piped for water, steam, air, and welding gas, and should be well lighted both by natural light and artificial light. A sufficient number of outlets should be provided for drop cords and for operating electric welding machines and portable motor driven saws, joiners, etc. It is recommended that pipe lines in so far as possible be placed overhead. Underground pipe lines or pipe lines in tunnels are as a rule difficult of access and to repair.

The transfer table should be at least 90 ft. long if the longest modern coaches are handled, and to this should be added the length of the tractor if one is used. The cars are moved either by a cable pulled by a winch on the table or by a tractor. The tractors in use are operated by electric storage batteries or by gasoline motors, and they have either broad treads on the tires for running on platforms and concrete roads or flanged tires for standard gage tracks.

When handling a shop having two car tracks it is recommended



Section of Truck Shop



repair shop proposed for a large railroad

that the transfer table have at least two tracks and if possible three, so that cars can be shifted with a minimum movement of the table. In the case of three tracks two of them are for holding cars from the shop repair tracks and the third is a "run-around" for the tractors.

Truck shop

The truck shop should be located near the repair shop. It is advisable to provide the shop with an overhead traveling crane of at least 15 tons capacity for the shifting of trucks inside of the shop. If the traveling crane is not installed the repair floor should be provided with jib cranes or monorail crane of one and one-half or two tons capacity to assist the workmen in lifting the heavy parts of the trucks.

There should be ample storage space for trucks in the vicinity of the truck shop. In large plants it may be advisable to run the truck shop crane over the truck storage platform. The truck shop should be well lighted and heated and piped for air, gas torches, and electrical welding equipment, and the floor should have a concrete base covered with wood blocks or equivalent.

Wheel shop

The wheel shop should be located adjacent to the truck shop so that mounted wheels can be quickly transferred between the two shops. Also the wheel shop should have about it sufficient storage space for mounted and unmounted wheels and axles, and have depressed tracks for loading and unloading mounted and unmounted wheels.

It is recommended to install traveling crane service over the outside storage platform where the shop is of sufficient size to warrant it. When the crane is provided the depressed tracks are not required. Where one wheel shop is to serve both the freight car and passenger car departments it should be readily accessible to both of these departments.

The pipe shop, air brake shop, machine shop and blacksmith shop should be located close to the coach repair shop. If possible they may be under the same roof as the repair shop and occupy a position similar to that of the machine bay adjacent to the erecting bay in locomotive shops. For securing better light and ventilation it is advisable to locate the blacksmith shop separate from the other buildings, and possibly the machine shop also. These shops should have easy access to a material storage yard provided with racks and bins for pipe, bar iron, steel sheets and steel sections, coal and coke, and other supplies.

Storehouse

The storehouse, or as it is frequently termed the "sub-store" in which are held stocks of bolts, nuts, washers, screws, and also small forgings and castings of all kinds, should be located where men are not required to travel any great distance in reach of it. Even in shops having messenger service where the material men provide the workmen with such materials, much time is saved by having the storehouse close to the repair plant. The storehouse should be provided with an outside material platform and unloading track, and crane service if it can be used to advantage.

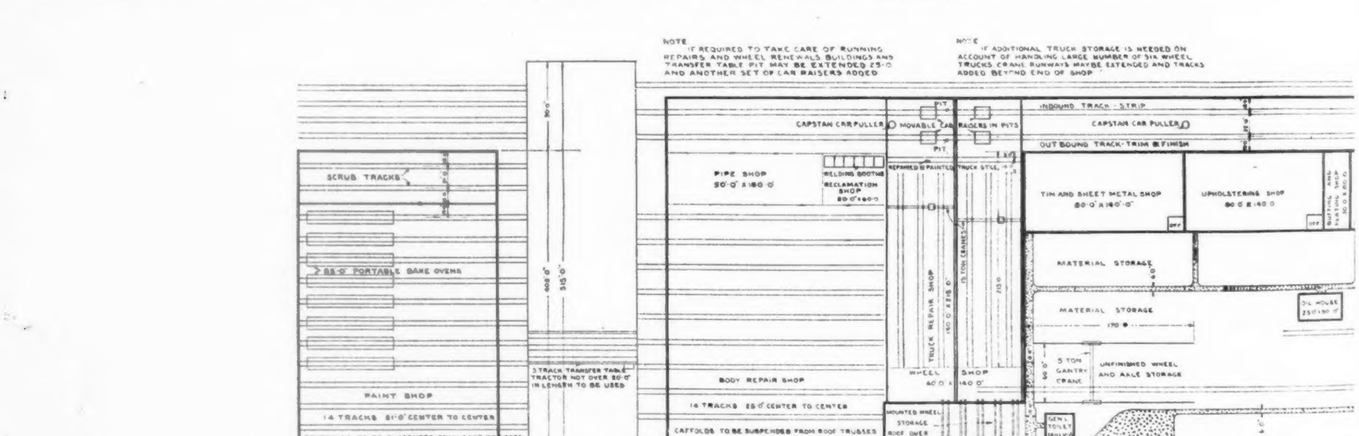
Planing mill

The planing mill is most conveniently situated outside of the main repair shop and in a separate building. The arrangement of machinery and the getting of material to and from the mill is most convenient when so situated, and also the fire hazard about the planing mill is greater than any other part of the repair shop except the paint storage room.

The lumber yard will naturally be located adjacent to the planing mill and the dry kiln interposed between the lumber yard and the planing mill. The lumber moves through the dry kiln, and from machine to machine in the planing mill with the least back motion, and thence to the shop or finished material storage. The planing mill should be steam heated, and have a concrete floor.

Cabinet shop and pattern shop

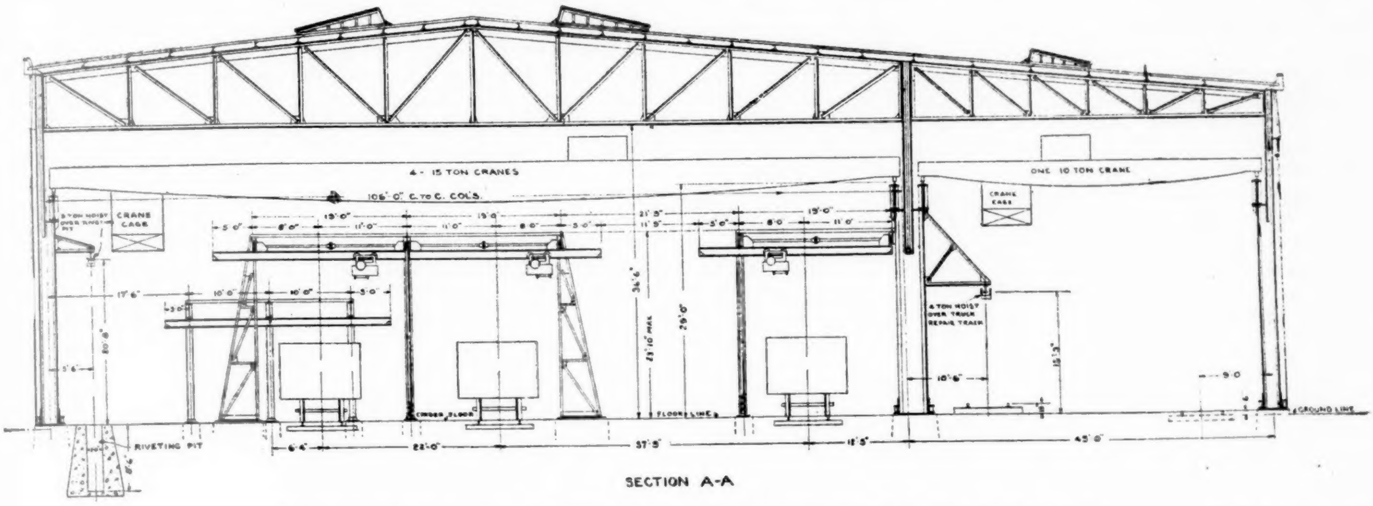
In many existing coach shops the cabinet shop is usually located on the second floor over the planing mill. There seems to be no particular reason for so locating this shop in a modern shop layout. If patterns in any quantity are to be stored a separate fireproof storage vault is advisable.



Plan No. 2—A typical passenger and freight car repair shop

The paint shop, like the repair shop, is preferably of the transverse track type having one or two cars on each track. The width of the building need be governed only by the aisle widths and the length of the cars on their trucks, as it is seldom that a car is off its trucks in a paint shop. Therefore, the building may be from 110 ft. to 125 ft. wide for a one car track shop, and from crete floor to catch the washings from cars. Wood block or other surfacing over the concrete is not required.

Particular attention must be given to the heating of the shop as its efficiency will depend upon the regularity and dependability of the heat. Where paint or varnish is applied with an air spray suitable ventilation should be provided. The shop should be piped



Drawing showing a section through the freight car repair shop—Plan No. 2

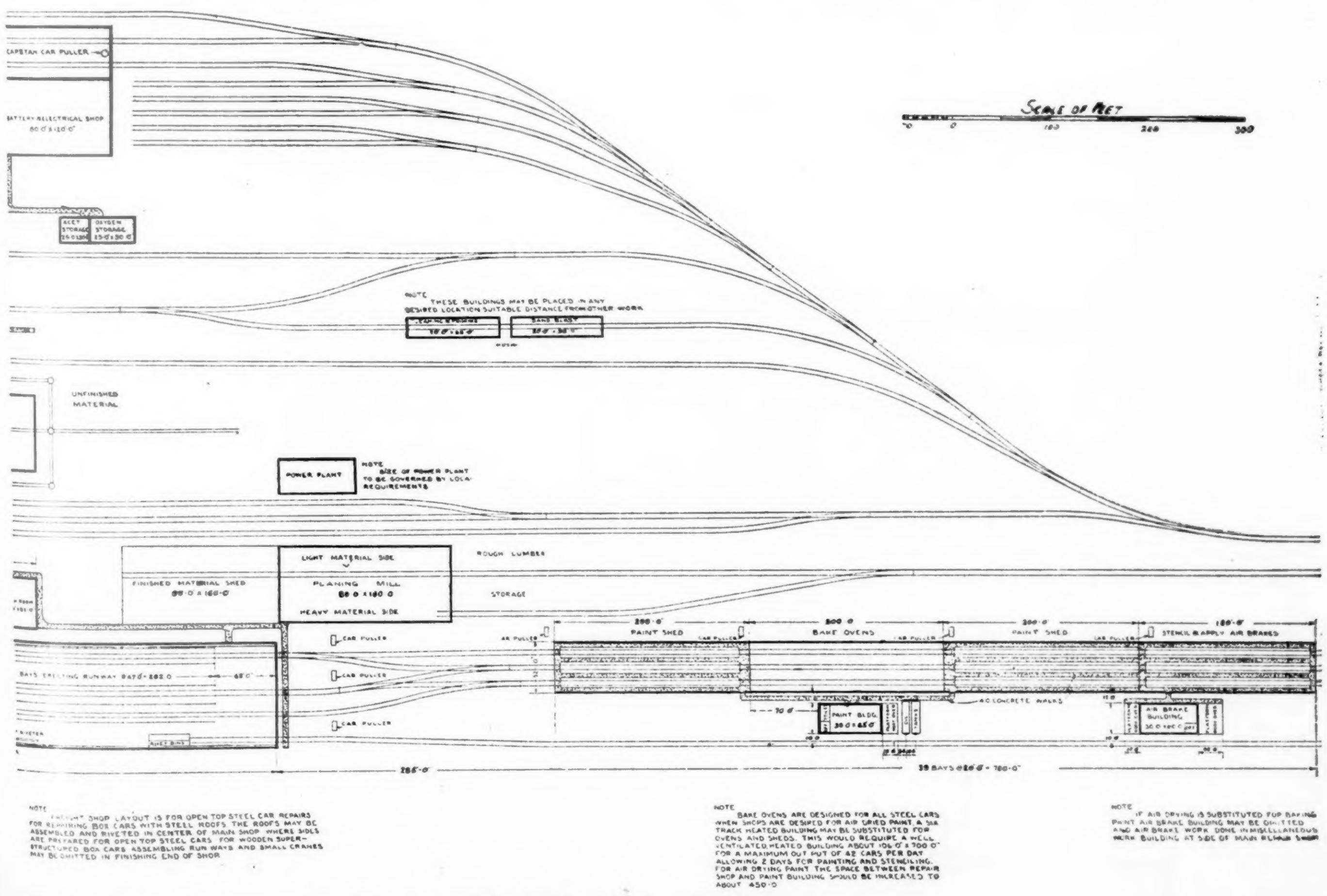
210 ft. to 230 ft. for a two car track shop which allows sufficient aisle space for materials and the workmen.

The tracks should be spaced at least 20 ft. center to center. The number of tracks required for a given output will depend upon the system of painting used. Where the bake oven process is used the painting time is about half that of where air drying is resorted to. The floors should be of concrete and amply provided with drains. In the scrub room troughs should be set in the con-

for water, air, and also gas if the latter is used for burning off paint. Scaffolding suspended from the roof trusses is necessary and the adjustable type is preferable.

Sand blast apparatus

Where paint is removed by the sand blast process the sand blast plant should be located at a distance of at least 250 ft. from the paint shop as the fine dust is easily carried by the wind. It is



—The truck shop is arranged to store the trucks inside the shop building

advisable, and in fact, almost necessary to locate a paint priming room adjacent to the sand blast building as the freshly sand blasted steel rusts almost immediately in damp weather. The priming room should be separated from the sand blast room by two partitions and a space in which air can circulate.

Platforms and roadways

Within recent years material platforms of timbers or old car sills have been superseded by concrete platforms, and such concrete platforms are to be recommended. They do not require renewing as do wooden platforms and also are more easily kept clean and material stocks maintained in order.

With modern shops much of the material is handled by power driven trucks with trailers such as electric storage battery trucks, gasoline tractor trucks, and the like. To operate such trucks efficiently requires concrete roadways and good floors in the shops. Concrete roadways and power driven trucks have practically superseded the former method of handling material by push cars and hand trucks. The concrete roads also serve as fire roads. Therefore, the location of the concrete roadways with reference to the several shop buildings and material platforms is of prime importance.

Fire protection

All railway shop plants comprise a hazardous fire risk and this is especially true of the car department particularly when wooden cars are being repaired. Therefore, ample protection against fire is essential. This protection should include:

1. An adequate source of water that can be supplied at fire pressure.
2. Water mains of sufficient size and properly located with respect to the buildings and furnishing convenient hydrants.
3. Trained fire department of the shop employees supplemented by protection from the city fire department.
4. Concrete fire roads kept clear of obstructions and having easy entrance for city fire department.
5. Sufficient hose reels in buildings, water barrels in lumber yards, and chemical fire extinguishers in paint shop or about especially inflammable materials.
6. Automatic sprinkler systems particularly in planing mill and paint shop.
7. Valves on pipe lines outside of buildings so that gas, water, air, and steam can be shut off from the buildings in case of fire, also switches on outside of buildings for cutting off electrical power and light lines that serve the buildings.

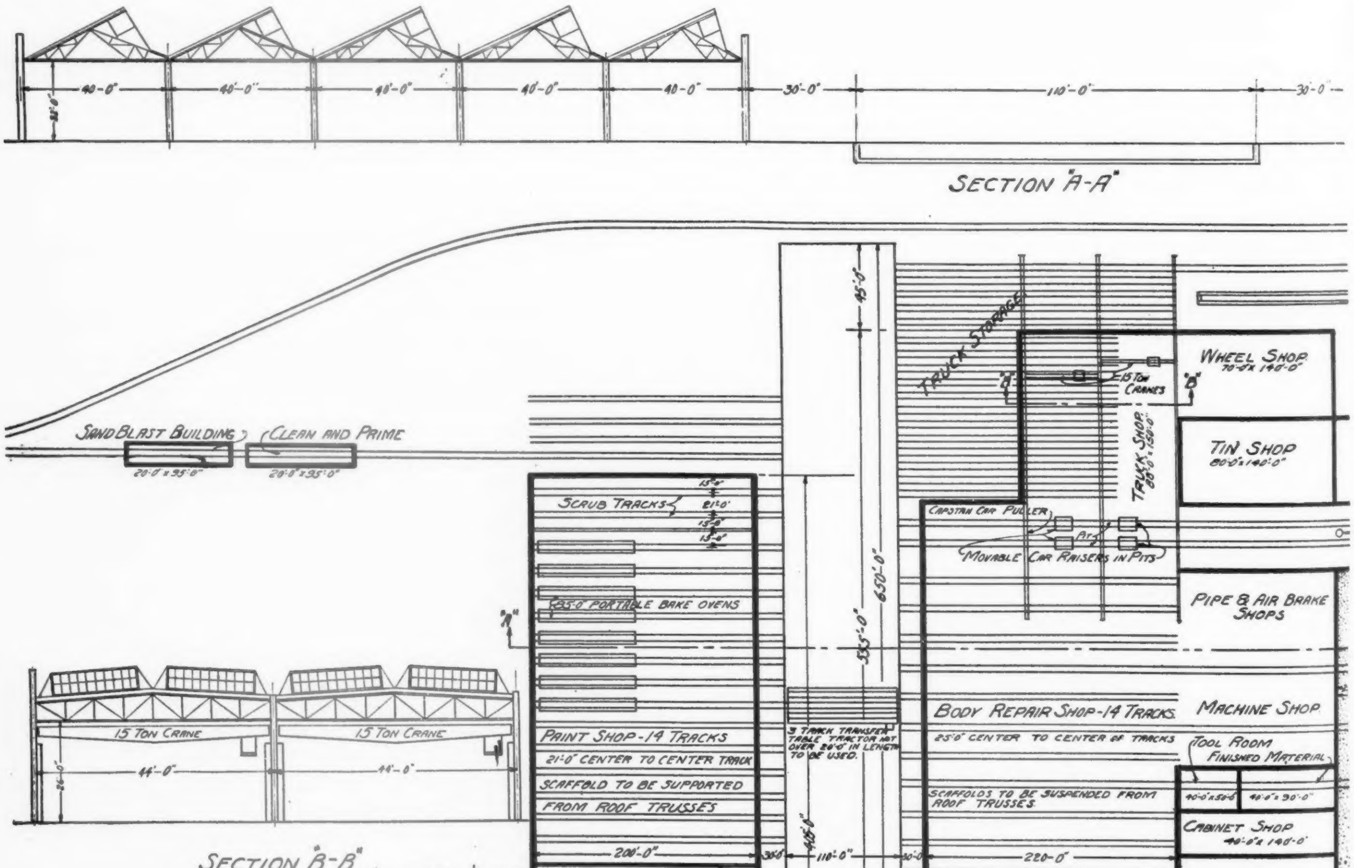
The report is signed by W. A. Callison (chairman), C. I. & L.; A. C. Davis, Penna.; I. S. Downing, C. C. C. & St. L.; B. P. Phelps, A. T. & S. F.; H. Gardner, B. & O.; J. Burns, C. P., and G. S. Edmunds, D. & H.

Discussion of plans

The layout shown in plan No. 1 is adapted only to a very large railroad. It follows the general system of repairs both in the passenger and freight car departments. The plan necessitates the moving of trucks on the transfer table which is not required in plans No. 2 and No. 3. This plan also separates the wheel shop, machine shop and blacksmith shop by some distance from the coach shop. The yard crane, however, connects these shops with the freight car shops. The tin shop is located in the coach repair shop instead of near the upholstering and electric departments as shown in plans Nos. 2, 3 and 4.

In plan No. 2, the machine shop and blacksmith shop are separated from the repair shop building but are connected to it, while the pipe shop is in the repair shop proper. The truck shop is so arranged that practically all the trucks are stored inside the shop buildings.

The truck shop in plan No. 3 is located so that a large portion of the trucks can be stored outside. Also the wheel shop has a



Plan No. 3—A proposed typical passenger car repair shop—

large outside storage platform. Unfortunately, the machine shop and wheel shops are separated by the tin and pipe shops. However, with this location of the pipe and machine shops, easier access to the storage platform from these shops is obtained. The cabinet shop in this plan is located inside of the shop building.

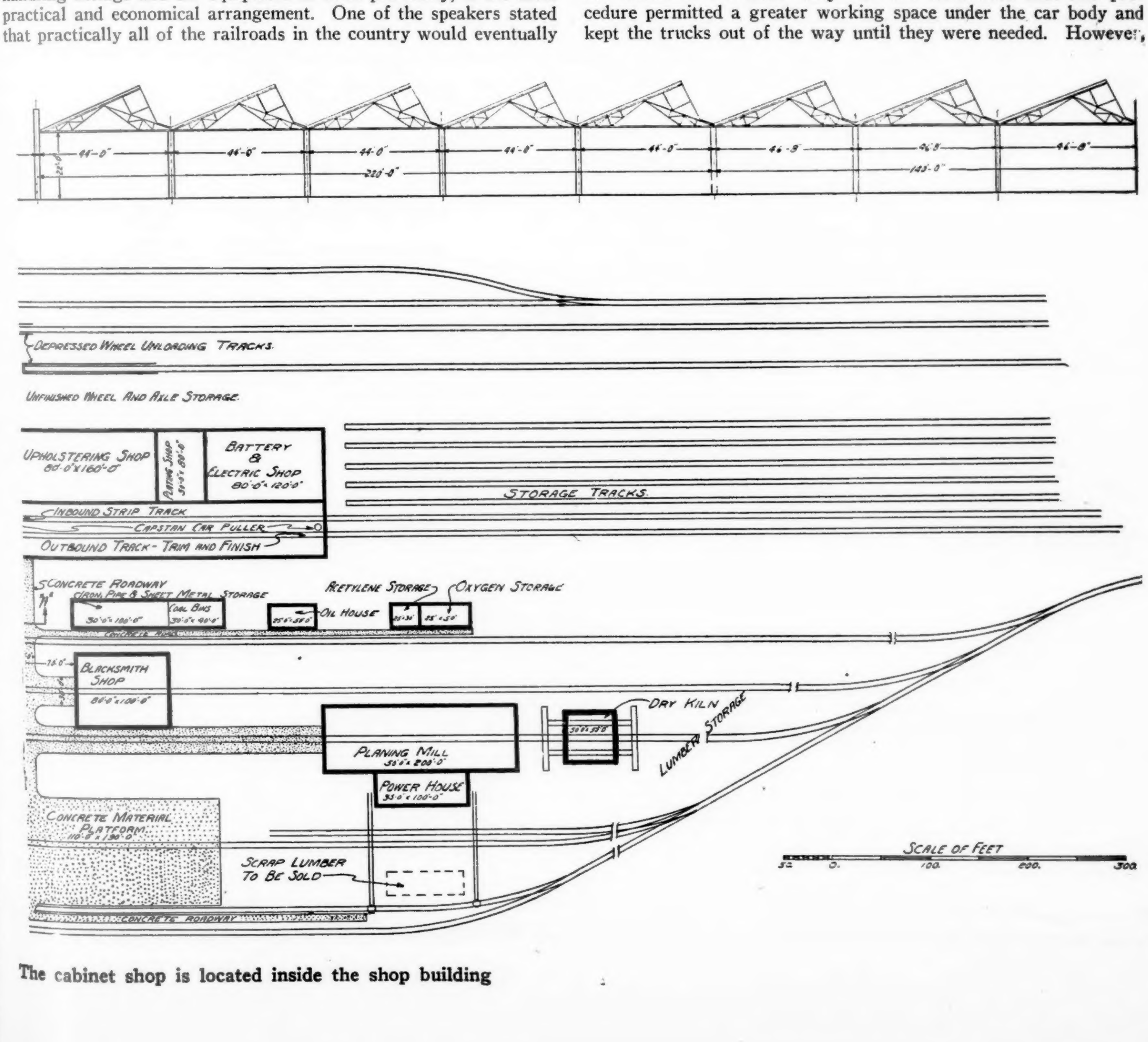
Plan No. 4 is for a smaller plant and locates all of the auxiliary facilities near the inbound and outbound tracks, including the cabinet shop next to the upholstering and varnish rooms. This plan also places the other auxiliary shops such as the pipe shop, blacksmith shop and machine shop, back of the erecting bay of the repair shop. All of these shops have access to the outside material platforms. In this plan the truck shop is supplied with a crane which operates not only over the truck shop, but over the wheel shop as well. The location of the varnish and paint storage of this plan differs from the others submitted.

Discussion

During the discussion the point was brought out that as there was very little wood in a modern passenger car, new passenger car shops should be designed primarily to handle cars of steel construction. With cars of steel body and underframe construction, all metal truck frames and rolled or forged steel wheels, the necessity of locating car repair shops in conjunction with freight car repair shops, in order to use the facilities common to both departments, is not essential. That many mechanical department officers could very well devote more attention to the study of scheduling and routing of work in the shops together with the systematic delivery and handling of material was also brought out. It was generally conceded that the plan of having both the inbound and outbound tracks adjacent, with miscellaneous shops for handling fittings and car equipment in close proximity, is the most practical and economical arrangement. One of the speakers stated that practically all of the railroads in the country would eventually have to provide facilities and equipment for repairing cars of either the gas-engine or gas-electric type and in some cases, even the full motor propelled type. While no radical changes in the plans shown in the report would be required, suitable shop space must be required for repairs to trucks, gas engine, generators and motors with which motor cars are equipped.

The problem of adapting an ideal shop layout such as proposed in the committee's report to all locations, received considerable comment. Conditions vary so much in the several districts of even one railroad that it is impractical to lay down a standard shop plan for all railroads. There are, however, certain fundamentals common to any district that should guide the designer of a shop, among which are a minimum cost of permanent installations; maximum efficiency with minimum idle time of tools and labor, and adequate provisions for safety and sanitation. Any proposed shop plan must justify its cost in actual reduction of repair expense-time to a minimum. A mere convenience is not satisfactory. One of the speakers remarked that it had been found on the road which he represented that the stripping and trimming could be performed in the building and on the tracks assigned to washing and painting, respectively. Two movements of the car were thus eliminated in shopping and the need for a special building is avoided. The trimmings, when stripped, can be loaded on special trucks and hauled in trains to the shop where they are handled. They can be collected in a reverse manner and delivered to the car whenever required.

The method of handling truck repairs received considerable discussion. It seemed to be the general sentiment that the best method of handling truck repairs was to remove the trucks from under the car and place the car body on horses and then move the trucks to the truck shop. It was considered that this procedure permitted a greater working space under the car body and kept the trucks out of the way until they were needed. However,



The cabinet shop is located inside the shop building

a number of the members spoke in favor of keeping the trucks under the cars until they were ready to be repaired.

A motion to accept the report and to continue the committee for the purpose of developing recommendations for freight car shop layout was carried.

The conservation of fuel

By F. H. Hammill

Executive vice-president, C. R. I. & P.

The following is an abstract of an address by F. H. Hammill, executive vice-president, C. R. I. & P. on the subject of fuel conservation.

The public is getting pretty critical about how we operate railroads. I have heard President Aishton of this Association say that we are going to be called upon to show whether or not we operate the railroads efficiently. And one of the big problems is what you are doing in locomotive performance; are you doing it cheaply or not.

I drew up some figures that I think are rather gratifying. It shows some things that have been accomplished. I find that on the Class 1 railroads in freight and passenger service in 1924 as compared with 1920 there was an increase of 4.4 per cent in gross ton miles, or an increase of 40 billion ton miles.

In doing that there was a decrease of 9,000,000 net tons of coal consumed, or 10 per cent. There was a decrease of $132,000,000, or 35 per cent. There was a decrease from 197 lb. of coal per 1,000 gross ton miles in 1920 to 149 lb. in 1924, or a decrease of 24.4 per cent.

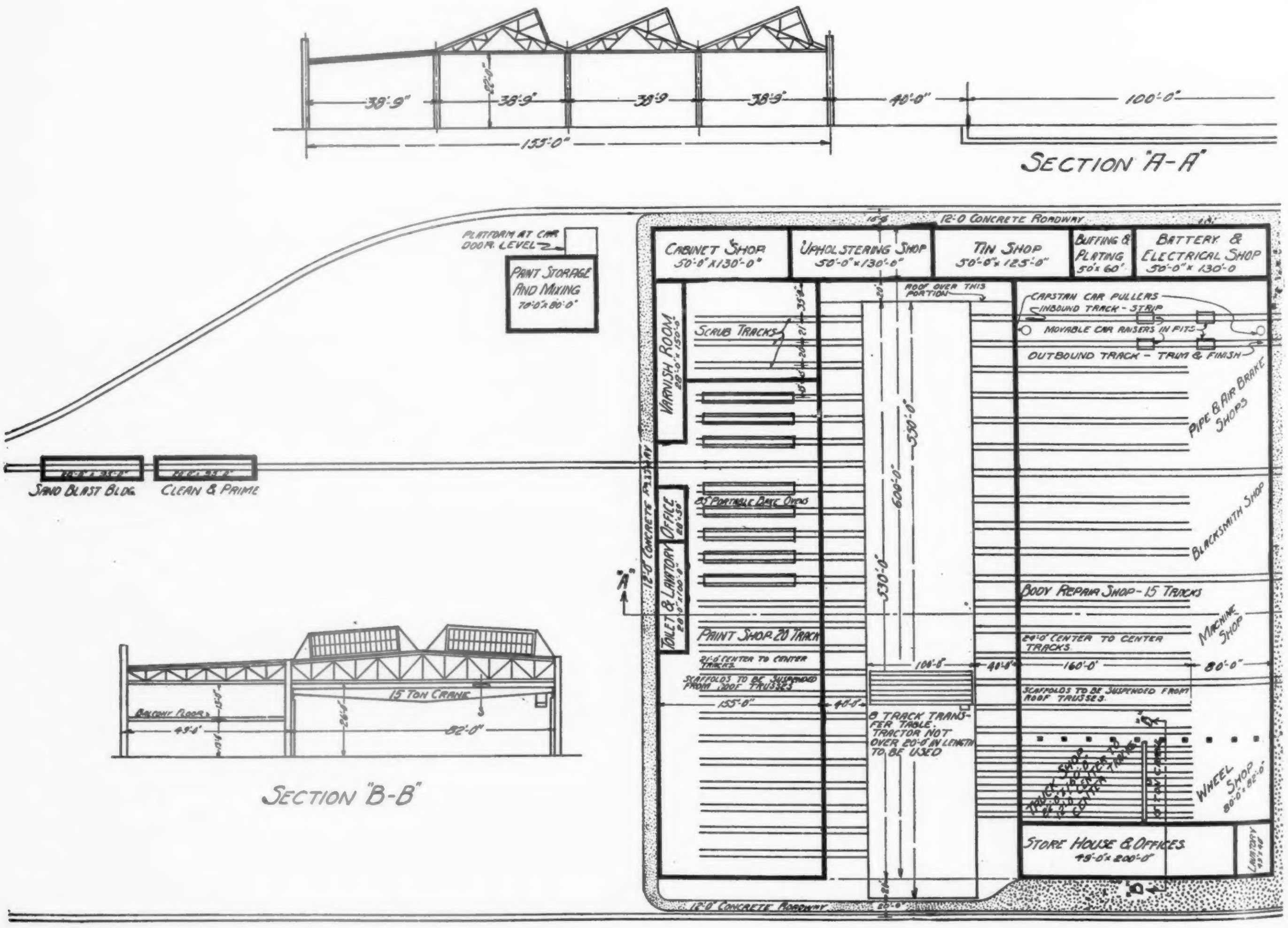
In passenger service there was an increase of 1.4 per cent in passenger car miles with a decrease of coal consumed of 8.6 per cent; a decrease of 9.6 per cent in pounds of coal per passenger car mile.

Taking the two services together we find that in the five-year period there was a total decrease of 9.6 per cent in amount of coal consumed, or 11,900,000 tons. There was a decrease in cost of coal of $180,000,000 or 34.8 per cent. That speaks fine for the mechanical men. The operating man is responsible for the coal. I know at one time it was quite the vogue to make the mechanical man absolutely responsible for the consumption of coal. I take a different position from that. I think the operating man should go with the mechanical man to the limit on the responsibility for that performance.

In the work of the joint committee of the American Railway Association and the International Railway Fuel Association on coal conservation we have been giving quite a little study recently to whether we had gone as far as we ought to as a joint proposition. We are going to win or lose as a transportation machine, not as individual railroads, but on whether we delivered the goods as transportation men. We all know what we have done so far as individual railroads in looking after this coal conservation. The question in the minds of the committee is, shouldn't we do something as a joint proposition. One of the things that I want to call your attention to is this: There were some very fine papers prepared on the question of fuel economy in book form. We find through the committee on coal conservation that they were not distributed as much as we on the committee feel would be of value to the railroads. I would like to call your attention to that so you may look into it.

The next thing is, should we adopt some method of unified testing. We make tests on our various railroads. There is a question in the minds of the committee if it is not necessary for us to go beyond that, not only to defend ourselves in connection with rates and in connection with our transportation as a whole but also to help us to bring about the results we ourselves consider necessary.

Our committee has made a recommendation to the A. R. A. as to whether we should not avail ourselves of some of these



Plan No. 4—A proposed typical passenger

colleges that have good testing plants so we can get some universal information. We all know what the superheat has done for the locomotive. We have other appliances that we know about. If we had some plan of that kind, couldn't we get more detailed information?

We ought to get our problems before the people just the same as other groups get their problems before them. If I have any criticism to offer at all about the transportation business it is that we have been a little too prone to lay back and not talk our subject. The time has come when we should talk.

At the Illinois State University, at Purdue and I think also at Iowa State College are good testing plants. If we could get together as an Association and work out some plan of utilizing these plants we would not only develop the information for the railroads as a whole but we would come in contact with the boy getting his education. He goes back home and gets into some little argument there about the railroads, how they are conducted and whether they are properly conducted. The boy says, "I think they are because right at the present time at the Illinois University where I am going we have locomotives there testing them out. Why? So as to reduce coal costs and enable the railroads to operate as cheaply as they can."

Report on locomotive utilization

The Joint Committee on Utilization of Locomotives presents herewith a report of progress. The committee has collected and analyzed considerable data on this subject, and has conducted some field surveys of operating conditions and performance. From this study, it is evident that the railroads generally are fully alive to the importance of this subject, and very creditable performance is being made.

The performance indicated by these surveys and studies of the Committee is as a result of the careful application of the following principles:

1—Locomotives are given such maintenance attention at monthly periods, preferably at certificate time, to condition the locomotive to run to the next monthly repair time with the minimum of light running repairs. This plan reduces materially the average mechanical time held at terminals, is a great factor in reducing engine failures, and provides a definite plan of running maintenance for keeping the locomotive in better condition.

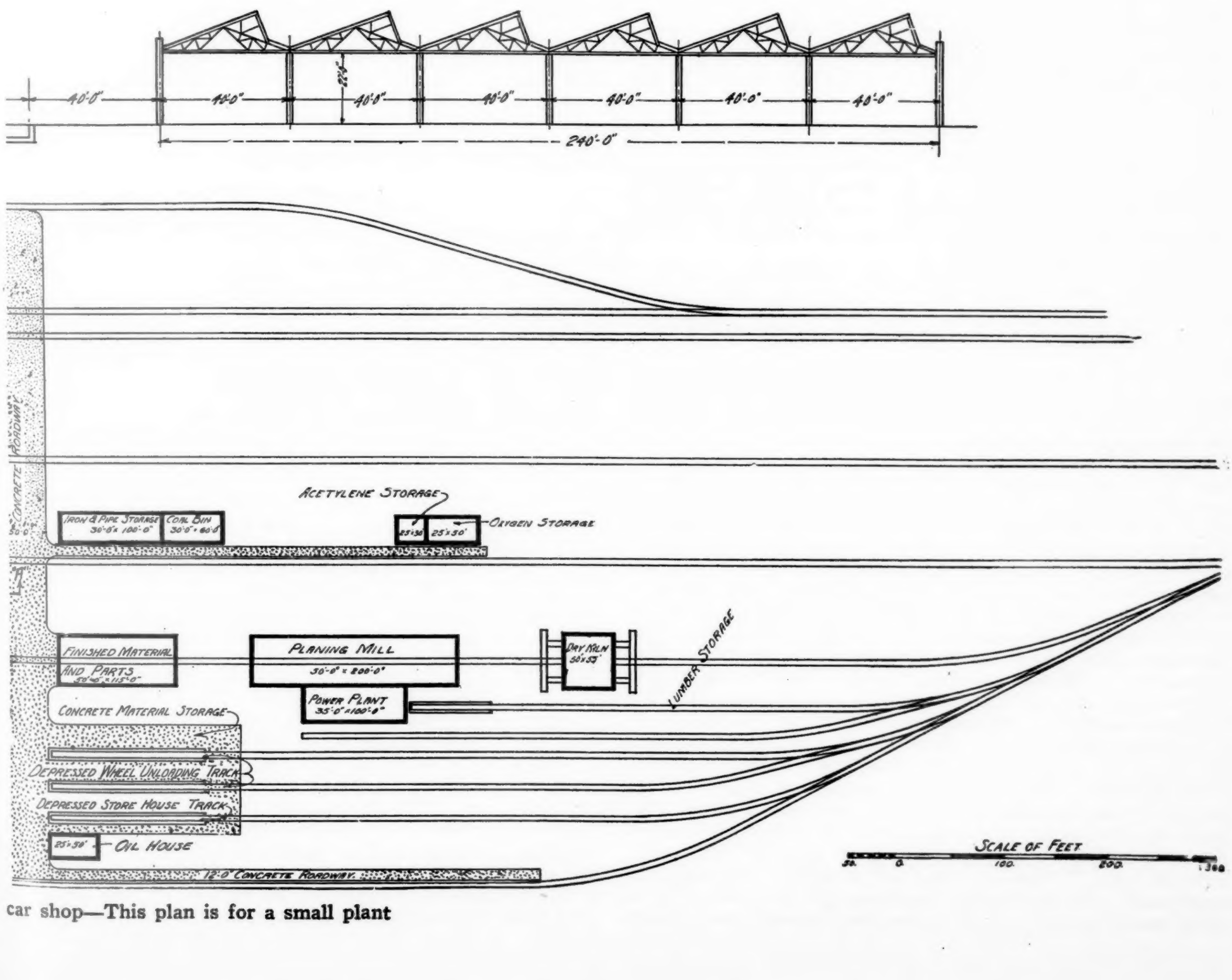
2—Detailed analysis of operating conditions on each division is made to determine the practicability and economy of increasing the miles per locomotive despatchment. The ability and capacity of modern locomoitves to make long sustained runs successfully has been definitely established.

3—Methods pursued in placing locomotives in and withdrawing locomotives from reserve, are very carefully worked out and adhered to. Consideration is given to placing this on miles per day basis, and placing the responsibility therefor on the division people. Specified miles per day are established for all classes of service for each division. Authority and responsibility is definitely placed on the division trainmaster and master mechanic for the number of locomotives in service to maintain this mileage.

4—Time for initial and final terminal delay at each point is established. Consideration is given to the location of route between engine house and yard, and interference encountered in this movement. Consideration is also given to relatively low cost capital investment improvements that will expedite this movement. Definite responsibility is also placed for the maintenance or improvement of this established figure with a local transportation officer.

5—The maintenance of specific locomotives is assigned to specific engine houses, and the utilization of inadequately equipped terminal facilities for turn-around purposes only.

6—Methods followed at yard offices in computing train loading and supervision held responsible therefor is also carefully in-



car shop—This plan is for a small plant

vestigated and studied. This matter is also followed up by the operating officers.

7—Consideration is also being given to re-location of or additional fuel and water facilities with reference to stops fouling the yard or cross-over switches, the location of these facilities with reference to the main tracks and the development of plans predicated on extended runs for correct location of facilities.

8—Statistics relating to performance of locomotives are carefully maintained and studied as relating to average miles per locomotive per month, gross ton miles per train mile, gross ton miles per train hour and related transportation statistics.

9—Thorough consideration is given to the reduction of freight train road delays with reference to despatching, spacing, overtime, relatively low capital investment improvements, and the method of supervising outlying points where congestion often exists and points where fuel and water are obtained.

10—Prior classification is obtained as far as possible and restriction of pick-ups and set-offs reduced to a minimum number of trains.

Where the greatest utilization of locomotives is obtained, and the best performance found, the above principles are being applied by operating officers on each division. Also, the operating and mechanical officers of the entire railroad are displaying the greatest interest in the subject. The committee invites suggestions and information as to the other practices which have been found effective by the members.

Upon request, executive officers of railroads will be supplied with confidential copy of reports of field surveys made by the committee.

[Attached to the report were tabulations of condensed operating statistics of a selected number of roads and of all Class I roads.—Editor.]

The report is signed by the following:

Representing Operating Division: T. B. Hamilton, vice-president, Pennsylvania; J. T. Gillick, general manager, Chicago, Milwaukee & St. Paul, and A. E. Ruffer, transportation manager, Erie.

Representing Mechanical Division: W. H. Flynn, superintendent motive power, New York Central; W. H. Fetner, chief mechanical officer, Missouri Pacific, and O. S. Jackson, superintendent motive power and machinery, Union Pacific.

Discussion

O. S. Jackson (V. P.) briefly described the system of making running repairs periodically on the Union Pacific. Locomotives, he said, are now in better condition, as reflected by a notable reduction in the number of engine failures. The figures per 100,000 locomotive-miles being as follows:

Year 1920	3.57 failures
Year 1921	2.10 failures
Year 1922	3.29 failures
Year 1923	1.54 failures
Year 1924	1.11 failures

Since the adoption of this plan maintenance costs have also been reduced. While it was not considered that the plan itself was entirely responsible, it was felt that it had an influence on the reduction of costs of running repairs. It was also a factor in increasing the mileage between general overhaulings. The plan used is as follows: When a locomotive is due for the regular monthly inspection required by Federal law, it is held long enough to be given such attention as is necessary to put in condition to perform satisfactory service until the next monthly Federal inspection is due. This work is handled along definite lines and under certain prescribed rules for each locomotive held, depending on its condition, length of time out of shop, class of service, etc. With the ordinary trip inspections and ordinary light running repairs during the intervening time, locomotives can be, and are, put in condition to operate successfully between monthly inspections.

The Union Pacific, Mr. Jackson said, has been able to reduce its active locomotive assignment by about 25 per cent as a result of increasing the miles per locomotive despatched, and as a result of this experience has extended this method of operation until all main line power, both freight and passenger, are assigned to long runs. The only exceptions are the local and branch trains. Passenger locomotives are now assigned to runs of from 483 miles to 640 miles in length and freight locomotives from 225 miles to 337 miles in length. From an economical standpoint this method of operation has met the fullest expectations, he said; the saving in locomotive investment and in intermediate terminal improvements and maintenance and the reduction in the amount of fuel used at intermediate terminals, represents a large saving in operating costs. In addition to the saving in fuel used on the locomotives at intermediate terminals, there has also been a considerable reduction in the amount of coal used in the power plants of these terminals. As an instance he cited the saving of 540 tons per month at the Rawlins, Wyo., power plant, by running freight locomotives through from Green River, Wyo., to Laramie, with practically no increase in the amount used at these two terminals.

J. M. Nicholson (A. T. & S. F.) stated that the investigations of the committee show a mileage of from 11,000 to 12,000 per month for passenger locomotives and of 5,000 to 6,000 per month for freight locomotives on portions of certain railroads, and that such mileages are resulting where locomotives are in productive service approximately 50 per cent of the time. He called attention to the fact that locomotives are being turned at terminals on some railroads operating long runs in 12 hours, of which approximately 8 hours is required for mechanical attention and 4 hours for transportation delay awaiting trains, and suggested that if this represents the minimum amount of time necessary, a greater locomotive utilization will result if a reduction of terminal time to this figure can be effected. He called attention to the fact that conditions existing on certain divisions lend themselves best to turn-around runs and in others to the regular assignment of locomotives to crews, while in some cases the best results may be obtained by pooling the locomotives on a single district, with turntable attention at one terminal and all maintenance taken care of at the other. He said that the best utilization, however, is being made by extending runs over more than one operating division and that this operation is recommended by the committee wherever practicable.

The importance of having favorable fuel, water and weather conditions in order to operate extended locomotive runs successfully was referred to in the discussion, as was also the fact that the arrangement or proper coaling facilities on the main line must be taken into consideration.

J. Purcell (A. T. & S. F.) said that in running locomotives on runs from 349 to 600 miles during the past year or two it had been found that in addition to the fuel saved in firing up there were less firebox, flue and staybolt failures than before the long runs were adopted.

Report on locomotive design and construction

During the past year the Committee on Locomotive Design and Construction gave consideration to the comparative merits of hydrostatic and force feed lubrication for locomotive cylinders and steam chests, and the best methods of application; the standardization of taps and dies used by railroads, and standards for bolt and screw threads; definition of an engine failure; rail stresses under locomotives; standardization of water columns; removable hand rail columns; and special designs of engines. The committee had no authority to conduct tests to obtain original data on the subject of rail stresses under locomotives and no report was made. However, investigations are in progress at the present time, the results of some of which have already been published. Following is an abstract of the reports on several of these subjects.

Hydrostatic and force-feed lubrication for cylinders and steam chests

Inquiries sent to the manufacturers of locomotive force feed lubricators requesting a statement as to the number of lubricators in service or on order as of March 1, 1925, developed that there are now in service, or on order, force feed lubricators of the various types, as follows:

Nathan Manufacturing Co.		386
United States Metallic Packing Co.	McCord	694
Formerly Locomotive Lubricator Co.	Schlacks	1308
Edna Brass Manufacturing Co.		36
Madison-Kipp Corporation (Information not available)		
		2,424

These lubricators are distributed over quite a wide range, including 76 railroads and 13 logging or commercial plants owning locomotives.

The expressions received from the various railroads using force feed lubricators indicate that this method of lubrication is exciting

considerable interest, and as a general proposition is establishing a favorable impression. A total of seven roads co-operated with the committee in the pursuit of this subject. These reports embraced the comparative performance of hydrostatic versus force feed lubrication on a total of 22 locomotives. With the exception of four, these locomotives were equipped with hydrostatic oil delivery to one side and force feed delivery to the opposite side. The summarized results referred to, and from which some conception may be obtained of the influence of the method of oil delivery upon packing ring service, rate of wear and oil consumption, are shown in the table.

In preparing the table showing the relative results obtained from the two systems of lubrication, the record as obtained in passenger and freight locomotive service has been separated according to the class of service, following which a combination of the results, including both passenger and freight service, is also shown. There were 14 passenger locomotives under observation, during which time 38 valve rings in the hydrostatically lubricated positions, and 45 in the force feed lubricated positions were removed on account of being worn, broken or down. From these valve rings an average service of 13,471 miles was obtained with hydrostatic lubrication, and 11,749 miles with force feed lubrication. From these same locomotives there was a total of 72 and 104 cylinder packing methods of lubrication in order that a comprehensive idea of the results of this study as a whole may be obtained.

In passenger service a difference of 13.8 per cent in cylinder packing ring service in favor of hydrostatic lubrication is shown, while in freight service a difference of 33 per cent favorable to force feed lubrication is recorded. On the basis of radial cylinder packing ring wear per 10,000 miles service, the results from the two systems of lubrication are practically equal in passenger service, while in freight service a difference of 17.6 per cent is shown favorable to force feed lubrication. Considering the mileage obtained per pint of valve oil, a difference of 65.9 per cent favorable to force feed lubrication in passenger service is shown, while in freight service the difference is 16.6 per cent, favorable to hydrostatic lubrication.

In the consideration of the performance record to which reference has just been made, no striking difference between the two systems of lubrication from any basis of comparison carries through both freight and passenger service. In passenger service a better valve and cylinder packing ring performance was obtained from hydrostatic lubrication, while a better mileage performance per pint of valve oil was secured from force feed system. In freight service a better cylinder packing ring performance was obtained from the force feed system, while a better mileage performance per pint of

Hydrostatic versus mechanical lubrication of locomotive valves and cylinders

			Rings removed (worn, broken or down)						Cylinder packing ring wear					Causes of cylinder ring removals				Engine miles per pt. of valve oil			
			Valve			Cylinder															
Type of lubricator	No. of roads	No. of engines	Total no.	Total ring miles	Av. mls. per ring	Total no.	Total ring miles	Avg. mls. per ring	No. of rings considered	Total ring mileage	Total	Per ring	Per 10,000 miles	Broken	Down	Worn	Total	Maximum	Minimum	Average	Total Engine mileage
Passenger																					
Hydrostatic	5	14	38	511,917	13,471	72	547,182	7,600	20	488,631	1.298 in.	.065 in.	0.027 in.	32	20	20	72	49.1	15.9	30.5	
Mechanical	5	14	45	528,715	11,749	104	681,157	6,350	32	710,616	2.092 in.	.065 in.	0.029 in.	18	28	58	104	101.8	21.4	50.6	711,060
Freight																					
Hydrostatic	3	8	0	......	.....	22	43,007	1,954	11	46,944	1.123 in.	.103 in.	0.239 in.	1	2	19	22	48.5	13.6	32.0	
Mechanical	3	8	0	......	.....	25	65,004	2,600	15	68,738	1.357 in.	.090 in.	0.197 in.	1	5	19	25	42.9	12.6	26.7	121,034
Passenger and Freight (Combined)																					
Hydrostatic	7	22	38	511,917	13,471	94	590,186	6,279	31	535,575	2.421 in.	0.078 in.	0.045 in.	33	22	39	94	49.1	13.6	31.1	
Mechanical	7	22	45	528,715	11,749	129	746,161	5,784	47	779,354	3.449 in.	0.073 in.	0.044 in.	19	33	77	129	108.1	12.6	40.7	832,094

rings removed from the hydrostatic and force feed positions respectively. The average mileage per cylinder ring was 7,600 for the hydrostatic, and 6,550 for the force feed.

A representative number of rings removed were measured for radial wear at five equally spaced points around the ring from the ends, and from the mileage performance record of these rings the average rate of wear per 10,000 miles has been determined, which, for the hydrostatic lubrication, was .027 in.; force feed lubrication, .029 in., the rate of wear being practically equal. Comparing the mileage made per pint of oil there is a marked difference favorable to force feed lubrication since an average of 50.6 miles per pint of oil was secured as against 30.5 miles for the hydrostatic. Attention is called, however, to the wide range in the oil consumption figures as indicated by the maximum and minimum results. With hydrostatic lubrication the maximum and minimum mileage per pint was 49.1 to 15.9 miles respectively, while with the force feed lubricator the range was from 101.8 to 21.4 miles respectively.

In freight service, there was a total of eight locomotives under observation. The performance of the valve packing rings was not sufficiently complete to enter into the comparison. Considering the cylinder packing rings there was a total of 22 removed from the hydrostatic and 25 from the force feed positions. The average mileage made by these packing rings was 1,954 and 2,600 for the hydrostatic and force feed lubricators respectively. Comparing the performance on the basis of the average radial ring wear per 10,000 miles, the record shows a rate of .239 in. and .197 in. for hydrostatic and force feed lubrication respectively. The mileage per pint of valve oil in freight service was favorable to the hydrostatic lubrication, 32 miles having been realized as against 26.7 for force feed lubrication. It is necessary to call attention to these individual values established in the comparison of the two valve oil was obtained from the hydrostatic system. There is a slight difference favorable to force feed lubrication.

The committee, in reporting on the standardization of taps and dies and also on the accepted standards for bolt and screw threads, suggested that in view of the disposition of the railroads and the association to adopt screw threads which do not conform to the Sellers or U. S. Standard tables, particularly for special purposes, such as boiler work, pipe work, injector couplings, etc., the statement on page L-27 of the Manual, to the effect that "The Sellers or Franklin Institute system of screw threads is the standard of the Association" should be qualified so as to avoid conflict between this statement and other standards and recommended practices which have been, or may be, adopted.

The committee feels that in the case of thin castle nuts, whose use, insofar as locomotives are concerned, is confined almost exclusively to crank pins, knuckle pins, crosshead pins, piston rods, etc., the form and number of threads per inch in the nuts should be governed by the threading of the parts to which they are applied.

The committee also feels that the form of threads to be used for lubricator fittings should be definitely specified.

Attention has been called by the committee on Locomotive and Car Lighting to the fact that the association has no standards for bolts or machine screws smaller than ¼ in. diameter, which is the smallest size included in the Sellers or U. S. Standard tables. This committee has therefore undertaken the work of ascertaining the present practices of the various roads with regard to sizes and threading of machine screws.

Status of standard threads

Information has been received from 20 roads. Fifteen report having no standards of their own, but are either following, or rec-

ommend following, the A. S. M. E. standards. Three have adopted as standard a certain number of sizes which are included in the A. S. M. E. standards, but have not adopted the entire A. S. M. E. table. Two roads report having standards of their own which do not agree with the sizes and threading found in the A. S. M. E. tables. In view of the predominance of the A. S. M. E. sizes, it seems proper that the sizes and threads that are adopted for machine screws should be selected from the A. S. M. E. tables.

As the Operating Division has not yet appointed a committee to confer with this committee on engine failures a report of progress only is made. The following memorandum is submitted for discussion and with a view of obtaining the views of the members for the benefit of the committee for future consideration.

1—All delays waiting at initial terminal caused by some defective part of locomotive.

2—All delays on account of the locomotive breaking down, running hot, not steaming well, or having to reduce tonnage, on account of defective locomotive, making a delay at terminal, meeting point, junction connection or delaying other traffic.

The following will not be considered as locomotive failures:

(a) When locomotives lose time and afterwards regain it without delay to connections or other traffic.

(b) When a passenger or scheduled freight train is delayed from other causes, and a defective locomotive makes up more time than it loses on its own account.

(c) Delays to passenger trains when such delays are less than five minutes at terminals or junction points.

(d) Delays to scheduled freight trains when they are less than twenty minutes late at terminals or junction points.

(e) Delay when a locomotive is given tonnage in excess of rating and stalls on a grade, providing the locomotive is working and steaming well.

(f) Delays on extra freight trains if the run is made in less hours than the number of miles divided by ten.

(g) Locomotive steaming poorly or flues leaking on any run where a locomotive has been delayed (for other cause than defects of locomotive) on side tracks or on the road an unreasonable length of time, say fifteen hours or more, per 100 miles.

(h) Reasonable delay in cleaning fires and ash pans on the road.

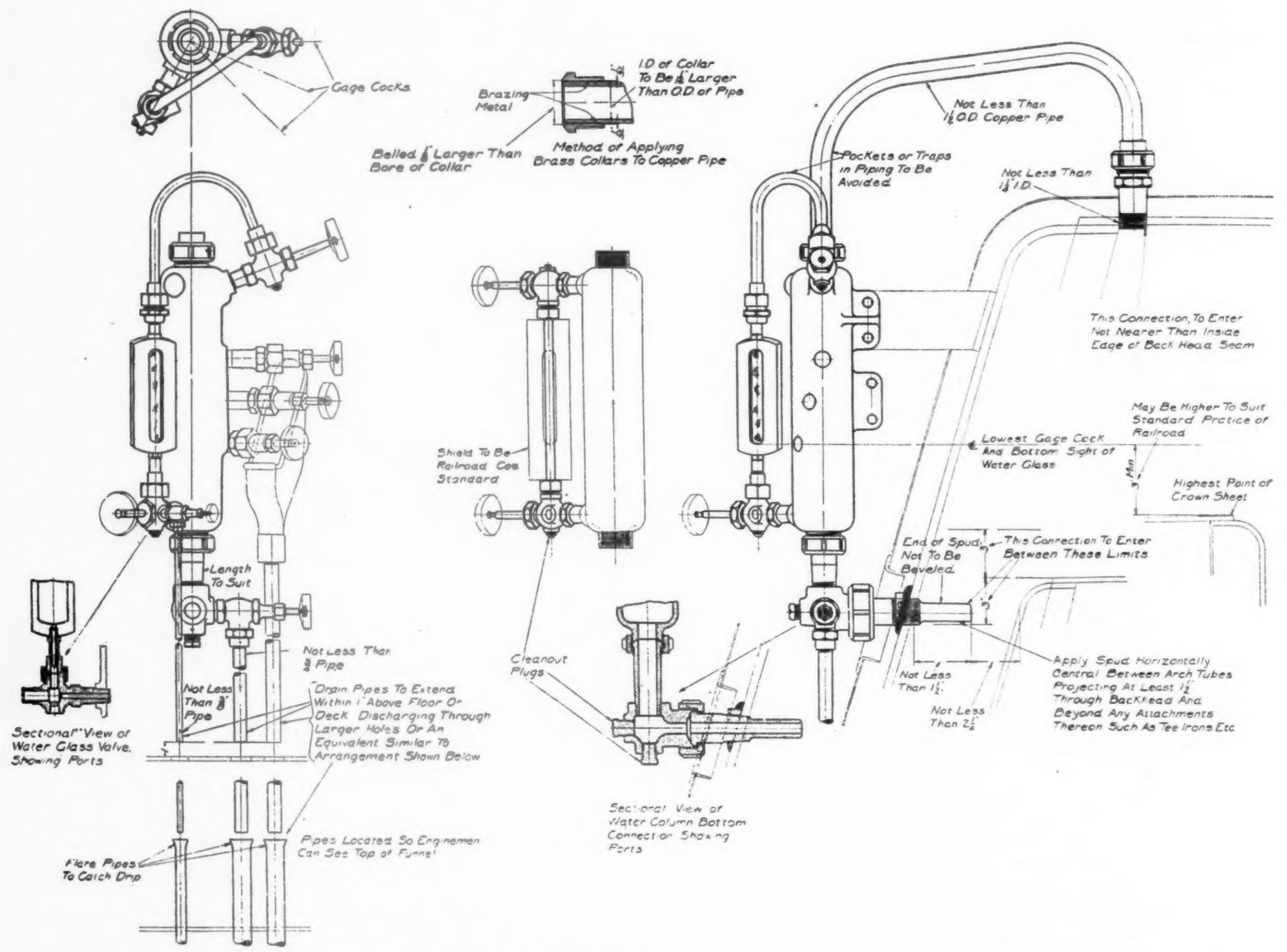
(i) Failure of locomotives coming from outside points to shops for repairs, whether running light or hauling a train.

(j) Delays due to insufficient time having been allowed in which to make needed repairs or to get the locomotive ready for the time the train is ordered to leave, when the operating department was so advised at the time locomotive was ordered.

(k) Broken draft rigging on locomotives and tenders, caused by a bursting hose of the train breaking-in-two.

(l) Delays to fast scheduled trains when weather conditions are such that it is impossible to make time; providing the locomotive is working and steaming well.

(m) Delay due to the locomotive being out of fuel or water, caused by being held between fuel or water stations an unreasonable length of time.



Drawing showing the application of the water column to the back head

Report on standardization of water columns

In the report on the standardization of water columns the committee made a total of 28 recommendations for future installations which are as follows:

1. All water columns and water glasses must stand vertically.

2. The water column should not be less than three inches inside diameter and of sufficient length to accommodate the length of water glass required for the operating conditions and to have a clear opening for the top connection of not less than 1½ in. inside diameter and be connected to the boiler with not less than 1½ in. outside diameter copper pipe, tapped into the boiler on the top center or in a location not farther to the side than nine inches and

not nearer than nine inches to the inside edge of the back head seam.

3. The top spud connection standard in the boiler to be not less than 1¼ in. inside diameter.

4. The bottom end of the column, to provide for vertical range in location, should be supported and connected to the boiler with a heavy cross connection and spud with clear straightway bored port ¾ in. diameter, with the cleaning plugs located opposite the horizontal and vertical ports. The spud should be of forged steel or bronze of ample strength to carry the weight of the column and attachments.

5. The bottom water column vertical connection to be not less than 1¼ in. inside diameter, preferably larger.

6. The back head of the sloping type may be reinforced with open hearth steel bevel washers, welded in place to provide horizontal application to the bottom spud.

7. The bottom spud must not be located in a radius or knuckle of the back head flange or immediately above the arch tube opening.

8. The inner end of the bottom spud must extend not less than 1½ inches through the back head and beyond any attachments thereon, such as the tee, angle iron, boiler braces, etc., to avoid location within a water eddy or pocket where water may dam up.

9. The inner end of the spud must not extend to or be less than 2¼ inches from the firebox door sheet and be located in a vertical range between 3 inches below and 3 inches above the back end of the firebox crown sheet.

10. The water column, vertical location, must be at such a height that the lowest gage cock attached therein, and the lowest visible reading of the water gage shall be not less than 3 inches above the highest part of the crown sheet and may be located higher, to suit the standard practice of any railroad.

11. The bottom connection of the water column must be equipped with not less than ¾ in. drain pipe and valve, preferably one-inch, which can be easily opened and closed by hand, so that the water column and connection may be frequently blown out. The drain pipes should be well braced and extend separately to within one inch of the cab floor or deck, and discharge the waste steam or water through a hole, slightly larger than the diameter of the pipe, or an equivalent arrangement whereby the leakage discharged through these pipes may be observed above the deck.

12. Water columns should be located well toward the center of the back head of the boiler to afford protection and to avoid violent fluctuation of the water while rounding curves. Extension handles to be applied to gage cocks when necessary, so as to bring them within easy reach of the engineman.

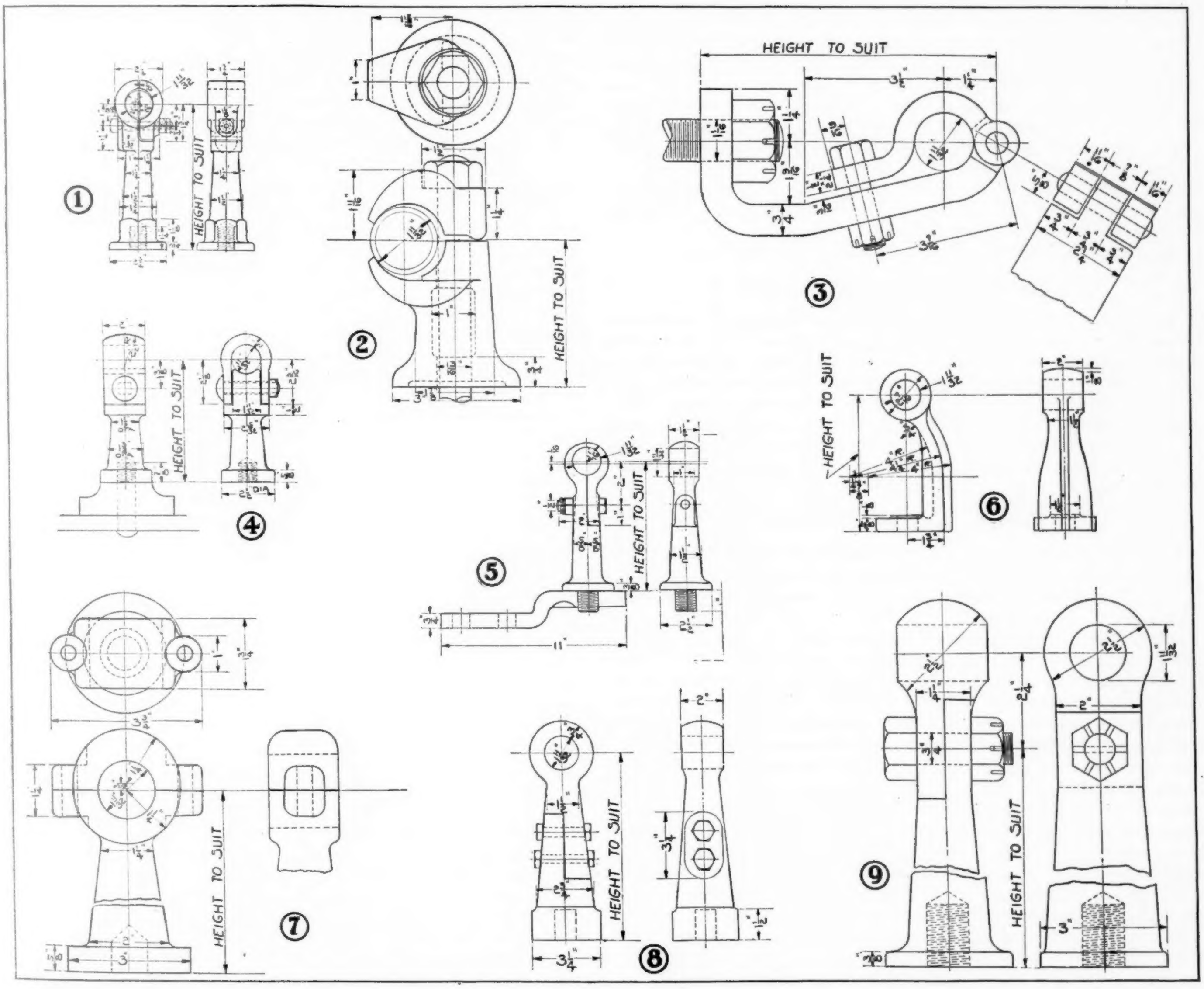
13. Gage cocks must be not less than ¼ in. inside diameter.

14. The top end of the water column should be securely braced to the back head with a brace sufficiently heavy to carry the weight of the column and overcome vibration.

15. The water column should be equipped with one water glass and three gage cocks.

16. The lowest reading of the water glass to be on line with the center of lowest gage cock.

17. The water glass of the Klinger or other Reflex type should



The nine designs of hand rail columns submitted by the Committee on Locomotive Design and Construction

have stems not less than ⅝ in. outside diameter and ⅜ in. inside diameter.

18. Tubular glass when used to be ⅝ in. outside diameter.

19. The top and bottom pipe connection to the water column and water glass must be applied without gaskets.

20. The water glass steam pipe connection not less than ½ in. outside diameter, preferably ⅝ in. outside diameter.

21. The water glass, Klinger or Reflex type, top and bottom valve connection bore ⅜ in. diameter, "and bottom connection provided with cleaning plug located opposite the vertical port and the side outlet for the blow off pipe connection."

22. The water glass, tubular type, top and bottom valve connection bore not less than ¼ in., preferably 5/16 in., "and bottom connection provided with cleaning plug located opposite the vertical port and the side outlet for the blow off pipe connection."

23. The water glass vision not less than six inches, preferably eight inches, depending on operating conditions.

24. The tubular type water glass when used must be equipped with a removable safety shield which will prevent glass from flying in case of breakage.

25. The water glass must be so located and maintained as to be quickly observable by the enginemen.

26. The water glass must be equipped with a bottom blowout valve and pipe not less than ⅜ in. diameter.

27. Steam pipes to be applied without sharp bends or pockets and provided with ball joint connections and belled at least ⅛ in. in diameter at the end in the bracing collar.

28. Application is shown by drawing.

Removable hand rail columns

The committee submitted nine different designs of hand rail columns which provided for the ready removal of the hand rail. Local conditions, the position of the hand rails and the uncertainty as to a general demand for such a design suggested the presentation of several designs which embodied this special feature. The report recommended that individual railroads considering the use of a removable hand rail should be in position to select from the several designs submitted, one that would probably meet their requirements.

Locomotive development

There has been a remarkable reawakening of interest in increasing the efficiency of the modern locomotive, with two main objects in view; first, fuel economy, and second, increased utility of the machine.

While this movement is attributed by some to the demands of the general public, it is the committee's opinion that it has been brought about by the necessity of improving the locomotive to meet changing conditions of traffic and to keep pace with the great improvements in roadway, terminals and general industrial developments. Coincident with this, great interest has been aroused in fuel saving devices due to the increase in fuel costs, forcing engineers, particularly in foreign countries, to investigate the possibilities of the turbine and internal combustion locomotive. These developments and the building of heavy electrical locomotives have served as a means of advertising the shortcomings of the steam locomotive, unjustly, thereby preventing to a great extent, a realization of what is being done to increase the efficiency of the orthodox types of steam locomotives.

The body of the report contains a summary of the progress being made in steam locomotive development along conservative lines; it listed the major improvements to ordinary designs of locomotives, cited examples by which increased boiler capacity had been obtained, gave an account of the advantages obtained by the use of positive limited cut-off and the development of the three-cylinder locomotive. The report also reviewed the economies effected by changes in operating practices and their effect on steam locomotive design, the condensing turbine locomotive, and the high pressure water tube boiler type locomotive, of which the "Horatio Allen" of the Delaware & Hudson is a typical example. Comments were made on the McClellan water tube fire box locomotive on the New York, New Haven & Hartford and the possibilities of high pressure locomotives.

Part two of the report was devoted to a summary of developments on the internal combustion locomotive. It stated briefly the characteristics of the heavy oil engines and the various problems connected with the application of Diesel power to locomotive service. The report confined its summary to the developments in electrical and geared transmission. It concluded with a discussion of the advantages and disadvantages of the oil-electric locomotive.

The report was signed by H. T. Bentley (chairman), C. & N. W.; H. A. Hoke (vice-chairman), Penna.; A. Kearney, N. & W.; George McCormick, S. P.; W. L. Bean, N. Y., N. H. & H.; C. B. Young, C. B. & Q.; M. F. Cox, L. & N.; W. I. Cantley, Lehigh Valley; C. E. Brooks, C. N.; G. H. Emerson, B. & O.; H. H. Lanning, A. T. & S. F.; A. H. Fetters, U. P.; M. C. M. Hatch, M.-K.-T.; S. Zwight, N. P., and R. M. Brown, N. Y. C.

Discussion

The greater part of the discussion of the report of the committee on locomotive design and construction was devoted to the McClellon firebox locomotive. V. L. Jones, New York, New Haven & Hartford, outlined briefly the history of the development of this type of firebox. The New Haven purchased two locomotives equipped with McClellon fireboxes in 1916, he said. These two locomotives went into the shop in 1920 at which time the back head and the bottom of the combustion chamber tubes were rebuilt and the locomotives replaced into service. Since then they have been in continuous operation, including the period during the strike, with a total expenditure of about $300 for maintenance.

Mr. Jones said that the difficulties encountered in the back heads of the original locomotives were overcome in the new design by providing separate braces and taking away from the tubes any other duty except to carry water and steam, and so placing them that they were able to expand and contract without interfering with the firebox strength in any way. In order to avoid bringing in too many new features on one locomotive, the new features were confined to the firebox construction. The designers did, however, he said, take advantage of the water tube construction and raised the pressure up to 250 lb. That necessitated stiffening up the rods and also required some modification of the valve gear so that the valve motion in full gear cuts off at 70 per cent of the stroke instead of near 90 per cent. No provision was made on this locomotive for auxiliary starting ports, and up to the present time, Mr. Jones said no difficulty has developed from the locomotive being slippery in getting out of holes with a heavy train.

Replying to a question as to the time required to wash a boiler equipped with a McClellon firebox, Mr. Jones stated that this work could be done a little quicker than on boilers of the ordinary type. Scale does not accumulate as rapidly on boilers of ordinary construction, he said, possibly due to the rapid circulation which has some scouring action.

The question of high boiler pressure also received considerable discussion and in this connection, the new locomotive, "Horatio Allen" of the D. & H., received considerable attention. G. S. Edmonds, Delaware & Hudson, stated that the total amount expended for maintenance on the boiler of this locomotive did not exceed $50, and that it required a little longer time to wash this boiler than that of the ordinary type. Until recently it was the practice to blow out the flues at each end of the run, he said. An experiment was made, however, in which the locomotive was run for one month without blowing out the flues. They were then washed out. This practice was carried out for a month or two and then instructions were issued not to blow or wash out the flues until the indications showed that it was necessary and these flues have been run three months without blowing. It has been found that this locomotive carries water equally well, if not better, than the normal locomotive. The highest normal operating speed for the "Horatio Allen" is 25 miles an hour with the limitation of 30 miles an hour. Mr. Edmonds also stated that notwithstanding these speed limitations which are strictly adhered to, this locomotive gets over the division much more rapidly than the other locomotives.

One of the speakers brought out the point that in all probability there should be no difficulty in using a double expansion engine such as the "Horatio Allen" with pressures as high as 350 lb., but when the pressure gets up into the range of 600 lb. to 1,200 lb. pressure, it was necessary to consider the utilization of a multi-stage engine and also to utilize those devices which would reheat the steam between stages as well. This, of course, means severe complication.

The opinion was also expressed that higher superheats are needed. One of the speakers who had some correspondence with the technical department of a locomotive building firm in Germany stated that this firm considered 660 deg. F. as a necessary steam temperature. In this country, the average temperature of 200 lb. pressure steam is 387 deg. F. By adding 300 deg. F. as recommended by the committee, a total of 687 deg. F. will be obtained

which is somewhat higher than the recommended German practice. It was suggested that the superheat of 200 deg. F. as recommended by the committee should be defined, whether an average or a maximum.

The chairman of the committee in replying to these remarks stated that to-day we are buying locomotives with supposedly 200 deg. F. of superheat, but are not getting over 135 deg. of superheat on an average, in freight service. The committee in pointing out that a higher degree of superheat than 250 to 300 deg. F., should be considered, was trying to indicate that at least 100 deg. more than has been obtained in the past should be the desired goal. The committee, he said, did not figure that this 300 deg. of superheat should be obtained by increasing the smokebox temperature abnormally, believing that good combustion means a smokebox temperature of probably 550 deg. F. and in addition, that the average superheat should come up to 225 deg. or 250 deg. and the maximum may go even as high as 350 deg. without any serious trouble.

In closing the discussion on locomotive development, one of the speakers advised the use of superheat at as high a temperature as lubrication will permit, because even though adding 100 deg. to the customary 200 deg. of superheat may increase the temperature of the exhaust steam 50 deg., there will still be a gain in efficiency because of the greater initial volume of the steam.

In the discussion of the sub-committee's report on water columns, it was suggested that the lugs of the water column shown in the drawing be changed from the horizontal hold type to the vertical hold type, as a number of the roads have experienced considerable trouble with the shearing of the bolts. As the recommended column was heavy, it was thought that the usual ½-in. or ⅝-in. bolts would not stand up. It was also suggested that as the bottom connection of the design shown was likely to be stopped up if any sludge accumulated on the bottom of the column, it might be preferable if that connection were made in such a way as to provide a mud pocket below the lower connection.

The point was also brought out that the manufacturers still have something to work out in connection with the construction of a force feed lubricator as none of them seems to have taken any definite steps toward providing an automatic means for controlling the temperature of the oil. This will have to be done before the force feed lubricator will become an ultimate success.

It was moved and seconded that the report be received and that the committee be continued for another year. The motion was carried.

Report on electric rolling stock

As a preface to last year's report, the committee offered under the title of Outline for Future Work, a general discussion of the economies of electrification as applied to existing steam operated railroads. Among the things exploited was the place held by the locomotive in railroad service with the possibility for more intensive operation and greater availability for service from motive power when proper study, planning and methods are applied. With that thought in mind it is well to consider means for obtaining maximum utilization.

A complete consideration must also include terminal electrification and the relative advantages of multiple unit train operation as compared with locomotive operation where such equipment is adoptable.

When the performance records of steam locomotives are reviewed over a considerable period of years with respect to availability for service, there seems to be indicated a retarding influence contemporary with the development of refinements and the increase in haulage capacity. These performance records further indicate that, whereas, the simple type of steam locomotive, as used some 25 years ago, was available for service approximately 75 per cent of the time, the modern steam locomotive seldom produces an average greater than 45 per cent. While obviously the addition of appurtenances and refinements, all of which improve the operating performance of the unit, will increase the amount of attention necessary to keep the locomotive in running order, yet, the decrease in service rendered cannot all be charged against such refinements. It would seem likely that a large percentage may be due to neglect in providing shop and terminal facilities in keeping with the requirements of the improved and larger power. Or perhaps the high percentage of unserviceable time may be due to a deficient understanding of the possibilities of the modern locomotive with its larger grate area, boiler dimension, general increase in proportions, and therefore greater margin of capacity as compared with designs of former years. Were these possibilities fully appreciated, then there would seem to be no logical reason for not providing and utilizing those facilities necessary for the prompt performance of shop and terminal work and thus obtain the maximum mileage performance between shoppings or terminal attention. Again precedent oftentimes places unnecessary restrictions on the realization of the wider range of service capacity of the modern locomotive, particularly where it is operated on the same division with power of a less recent design.

While it may appear inappropriate to dwell on deficiencies of the steam locomotive, nevertheless it is upon these deficiencies that great stress is placed by the proponents of electrification when the latter is under consideration. Such deficiencies should be taken into consideration by any road contemplating electrification and it seems only proper that cognizance be taken of them in this report. An outstanding advantage of the electric locomotive is the high percentage of serviceability as compared with the steam locomotive. Yet we cannot consistently compare them from this standpoint, unless provision is made for full utilization of the serviceability of which the modern steam locomotive is capable.

The steam locomotive of today is the product of many years of development with the view to simplicity and reliability with the result that the attainment of efficiency has been more or less sacrificed to that policy. Test locomotives have been built and successfully operated, under favorable conditions, whereby, through the utilization of stationary power plant practices, very high efficiencies have been obtained. However, it is quite doubtful that such types will become common, because the maintenance problem presented will greatly offset all other advantages. Generally speaking, the average thermal efficiency obtaining from steam locomotives is little greater than one-half that obtained by the operation of electric locomotives on power generated at first-class stationary plants, properly operated, and the advancement in this respect is more pronounced in the latter than in the former, because of the more favorable conditions. Restrictions as to space is not a factor, skilled operators may be employed with the view to obtaining high thermal and mechanical performance, and refinements in equipment may be instituted since the problem of maintenance does not exist in the same degree as in the case of the locomotive. The possibilities for high thermal efficiencies are very much limited in the case of steam locomotives; the opportunities in this respect are in nowise restrained when applied to stationary power plants of considerable size. However, it should be said in passing this point that the possibilities for sustained service with steam locomotives have not yet been attained and it can be said further that were the inauguration of a group of modern engines within a certain section attended with the same engineering skill and given the same support as is done when electrification is set in operation the results obtaining might prove more competitive with the electric power.

The trend of development for stationary power plants in the future undoubtedly will be toward higher initial pressures and temperatures with the object of obtaining higher thermal efficiencies. Such a tendency will have its effect upon electrification projects through a lower unit cost of power. This gain in efficiency will offset a part of the transmission losses or for the same overall efficiency, will permit longer transmission lines and in turn, the concentration of larger quantities of power in the individual plant or plants and of course fewer such plants.

As before mentioned, one of the pronounced advantages from electrification is the peculiar characteristic of this type of equipment which enables it to produce, under favorable surroundings, almost continuous service. Therefore, in laying plans for electrification, full recognition should be given this feature and traffic divisions, for one thing, should be so arranged as to permit long runs, or at least, continuity of runs that will make it possible to gain this advantage. Long mileage of electrified territory is, of course, favorable, but similar results can be accomplished by arranging for prompt return of power at the end of short runs.

The establishment of terminals and shop points has a great deal to do with making electrical operation economical. Repair facilities should be centralized in as few points as possible thus eliminating multiplicity of shop equipment and permitting the concentration of skilled workmen with a minimum capital outlay. Centralization of repairs within certain limits will react on the operation of the equipment to the extent of keeping it on the road,

whereas, with a shop too convenient there is always a tendency to hold the locomotive for minor repairs that can readily be handled at the inspection points. Electric locomotives are not subject to many disorders customary with steam power and in consequence repairs are not necessary at intermediate points. The terminal should be merely a dispatching point where but little work is done other than the ordinary running terminal inspection and such minor adjustments as may be found necessary. There is small need for machine tool equipment at terminal points, but it is advisable to have a liberal stock of small parts in order to make replacements when needed. Trains should be dispatched promptly with a view of keeping the power on the road with as little lost time at the terminal as possible.

Consideration must be given to the cycle of wear of the various mechanical parts and electrical equipment within each unit of motive power with a view of repairing or renewing such items as become necessary, thus keeping the locomotive in service for the longest period practicable. In this connection it is recommended that extra parts be kept in stock to the extent of providing major units such as complete running gears, traction motors, track units, etc., thus reducing the total of complete units to a minimum. The same may be said of multiple unit cars as far as maintaining complete major repair units is concerned. The situation is different however, to the extent that ordinarily the equipment reaches a repair terminal on each trip so that the inspection point and repair point in general coincide.

In the routine care of electric locomotives, a difference from steam locomotives is distinctly noticeable. A well designed and operated electric locomotive or multiple unit car, if properly inspected and repaired at periodic intervals, may be run between these intervals without any attention, except such inspection as may be necessary to determine that the car or locomotive is in a safe operating condition. The intervals at which the inspection and repair periods must be set can only be determined by operating experience and a careful study of the individual car or locomotive design, having in mind that careful inspection, with minor adjustments, will frequently prevent the necessity for extensive work. It is, therefore, recommended that facilities for testing and inspection of electric locomotives and multiple unit cars at periodic intervals be developed to a high degree, in order to obtain perfection in the operation, and thus reduce detention and intermediate inspection to a minimum.

Fullest utilization cannot be obtained, unless there is full co-operation between mechanical and transportation departments. The successful adoption of electrification requires a full understanding of its peculiar characteristics by all concerned. Educational measures should be inaugurated for this purpose and means for adequate instruction should be instituted sufficiently in advance that those having direct charge of the equipment may be fully acquainted with electrical matters and thus be able to handle the equipment in the best possible manner.

Where practicable, there is a great advantage in using locomotives of the same type for all services within a given district or territory. It will lend greatly to the flexibility of service, reduce the multiplicity of repair parts and operations, and be a large factor in gaining sustained service.

Official classification rule covering movement of gas and electric cars on their own wheels

During the year a special assignment was given the committee to study and recommend changed wording of Official Classification Rule No. 47. The rule now reads as follows:

Gasoline or electric motor cars, on their own wheels, gear wheels disconnected: Actual weight less fifty (50) per cent with a minimum net weight charge of 36,000 lb. each.. 5

Actual weight subject to minimum weight of 30,000 lb.

After due consideration of the features involved, the following wording was unanimously adopted as the proper wording of the rule:

Gasoline or electric motor cars, on their own wheels:

1st, Self Propelled Cars Other Than Electric Driven: Transmission or driving rods disconnected or transmission positively locked in neutral.

2nd, Electric Motor Cars: Not to be shipped with motors mounted on trucks:

Actual weight less fifty (50) per cent with a minimum net weight charge of 36,000 lb. each.. 5

Actual weight subject to minimum weight of 36,000 lb.

It is further understood that:

(a) No reference herein applies to electric locomotives or self-propelled cars shipped over rails on their own wheels and under their own power.

(b) Unless transmission or driving rods are disconnected as provided above, an attendant must accompany all such shipments. In any event it is recommended that an attendant accompany all such shipments.

The Rule as rewritten meets with the approval of both the Westinghouse Electric & Manufacturing Company and the General Electric Company.

Inspection rules

The sub-committee dealing with the subject of inspection rules of which J. V. B. Duer, electrical engineer, Pennsylvania, is chairman, is to continue without instructions until after the American Railway Association completes its conference with A. G. Pack, chief, Bureau of Locomotive Inspection, regarding new Interstate Commerce Commission inspection regulations covering locomotives other than steam operated.

Shop facilities

As most of the heavier electrification projects have been attempted to handle some certain service condition or capacity, their detail operations have likewise been arranged best to meet the requirements. In consequence, the facilities have somewhat suggested themselves and have grown with the development of the undertaking. At the same time, with the introduction of electric equipment to work with or replace steam equipment, the essential additional features for the dispatching or running repair stations originally laid out for steam are not extensive. In a general way, facilities prepared for steam constitute practically or nearly everything needed for electric and more. At the general repair shops, the situation is somewhat modified and controlled by the type of equipment. In laying out new shops for either dispatching or general repair work, there may be conditions that might be re-arranged to considerable advantage to improve the order of operations and efficiency.

With the change from steam to electric power, it is in some cases more economical to use multiple unit passenger equipment in place of electric passenger locomotives. When this is the case the passenger car terminal repair shop should receive careful consideration, and will probably require a more radical change than that compared with the steam locomotive dispatching terminal.

Multiple unit equipment

There are certain tools necessary for the maintenance of electric multiple unit equipment that must be added to those usually found in steam road passenger car shops. The design of equipment used on multiple unit cars is limited to such extent that the tools and other facilities are practically the same for both direct and alternating apparatus.

The major tools should comprise armature banding lathes, coil winding machines, commutator slotting machines, bake ovens, presses, test apparatus for magnet coils, field windings, separate lathe chucks for boring and fitting up motor and axle bearings and small tools for air compressor and control parts.

Inspection sheds should be provided to handle the required number of cars, and equipped with suitable well lighted inspection pits.

One of the most important facilities required in a well designed back shop is a large crane equipped with special hooks for lifting car bodies off their trucks and placing them on temporary or shop trucks. While most any type of car or locomotive shop would probably be suitable for multiple unit equipment, the output depends entirely on efficient handling of the truck repair work. Therefore, traveling cranes should be provided with sufficient capacity to handle complete trucks. Sufficient floor space should be provided between truck repair tracks for piling of repair material for assembly.

Locomotive dispatching or running repair stations

Treating on the facilities for the terminal handling of equipment in contra-distinction to repairs in connection with dispatching and running repairs, steam equipment essentially requires provision for coaling, cleaning fires and ash pans, supply water, hot and cold water for boiler washing and filling boilers, steam blower to accelerate firebuilding, suitable inspection pits, and a turntable or wye to handle engines for return trips. Practically none of these are necessary for the handling of electric power, except inspection pits, sand supply, water for rheostats, where used, and provision for fuel oil and water for passenger locomotives using a steam boiler for train heating purpose. Consequently, in changing facilities for the exclusive handling of electric power, they may

be materially less than for steam. For the handling of steam equipment, as also applies to electric power, custom practically establishes one of the terminals reached in the course of the daily run or trip as the home or principal dispatching station. At this station, the major part of the running repairs is made, and in the interest of handling the work to advantage and economically, facilities are provided accordingly and in excess of those provided at the other terminals or outlying points. The facilities needed at outlying points for the handling of electric locomotives may be little more than inspection pits, and provision for sand and water supply, depending upon the type of equipment in use.

One idea of the comparison between the inspection and running repairs for steam and that needed for electric locomotives is that the former takes minutes for the inspection and hours to make repairs, while with the electric it takes hours to find the trouble and minutes to make repairs. These figures may be exaggerated, but serve to illustrate the reversal of the conditions.

The actual serviceable time of heavier steam power has been found to be in the neighborhood of 45 per cent as against 85 per cent for electric locomotives. This wide difference in serviceable time is no doubt due in part to the small amount of time required for the work on electric locomotives, in that complete units can be renewed in a comparatively short time. The longer time put on the steam locomotive is accounted for largely by the almost constant attention which must be given to the firebox, flues, stokers, guides, valve gear, reversing mechanism, piston and valve packing and periodic boiler washing and inspection. For electric locomotives inspection pits and means for supplying engines with sand and oil at outlying points are all that is necessary, except where passenger locomotives are handled means should be provided to supply oil and water.

For the handling of steam locomotives at the principal dispatching stations a turntable or wye is generally necessary to turn the power for the return run, and an engine house of the conventional circular form, with its turntable, well supplies convenience for the routine inspection and repair work. Similarly a turntable has been found valuable in connection with a rectangular engine house for the handling of electric locomotives composed of two or more units, and certain units of other types. By having a turntable or wye time can be saved by withdrawing for repairs but one cab or unit of a locomotive composed of two or more units, and the substitution of another cab to make up a complete locomotive, thus keeping the maximum number of complete locomotives in service, and at the same time handling the repairs on the out of order cabs to the best advantage. In making such exchanges and also to equalize flange wear, it often becomes necessary to turn a cab end for end.

Where electric power has been put in the field replacing steam either partially or completely, the complements of tools needed at the principal dispatching stations will be largely governed by the type of steam and electric locomotives used. Different methods of handling the running gear work at the outlying and principal stations in conjunction with operating conditions, set up problems that must be worked out or adjusted by the railroad to best meet the requirements.

A working pit supplied with a suitable drop pit for wheel and truck work is a convenience that might be considered common to steam as well as electric power, and is as convenient at the general repair shops.

An overhead crane of greater capacity perhaps than used ordinarily at a steam locomotive roundhouse is practically a necessity, for lifting motors, transformers, rheostats, air compressors, and other heavy parts of the electrical machinery from the frames, either through the hatch in the cab roof or after the cab has been removed.

The tool equipment must be distributed between the principal dispatching station and back shop, depending on the distribution of the repair work between the principal dispatching station and back shop as well as on the relation of the shops and whether the principal dispatching terminal is constructed in combination with the back shop or as separate shops located some distance apart.

To handle the work on electric equipment at the dispatching station comparable with the work that would ordinarily be necessary on steam equipment the demands are nevertheless different, and the conditions might be better pictured by considering that in place of the locomotive boiler, steam cylinders, guides, crossheads and valve gear on the steam locomotives, the electric locomotive carries motors, phase converters, control apparatus, rheostats, switches and relays. In place of the steam locomotive cross head, certain types of electric locomotives have the jack shafts, gears or spring quills through which the power of the motor operates the locomotive. On an electric locomotive having the same general type of steam locomotive frame and wheel arrangement, the driving boxes, shoes and wedges, and brake rigging are practically the same. The side rods on an electric locomotive are practically the same as on the steam locomotives.

For electric locomotives having gear drive and motor armature mounted on the driving wheel axle, the maintenance work on the gear in a general way takes the place of operations corresponding to side rod maintenance. However, the total equipment necessary may be different.

The machine tools required at a steam locomotive dispatching station to maintain such parts would be practically the same for electric, and in the interest of handling the work to advantage, it has been found convenient to have at the principal dispatching stations tools such as a boring mill suitable for driving wheel centers and tires, a lathe of sufficient capacity to swing the largest motor revolving part, a 24-in. lathe, an intermediate size lathe for smaller motor repair work, a radial drill press, a slotter, vertical drill press, horizontal boring mill for bearings and bushings, press for removing and applying motor shafts and shaper, and facilities for repairing switches, relays, instruments, circuit breakers, etc.

For the major repair work which must be handled at shops corresponding to what are generally understood as back shops or shops where general repairs are made, some inexpensive changes might be made in arrangement of facilities and tools in an existing steam locomotive shop for the same general character of work on electric locomotives to improve the sequence of operations, as they differ somewhat between electric and steam power.

The boiler shop equipment can be eliminated, with the exception of a few tools for the rebuilding and repairing of transformers, rheostats, water and oil tanks and small boilers used on electric locomotives in passenger service.

In most steam locomotive repair shops, overhead cranes have been provided of sufficient capacity to lift a complete locomotive. A crane of sufficient capacity to lift a complete electric locomotive or one cab or unit composing an electric locomotive is desirable, where the design permits, though not always as necessary or as useful as for the handling of a steam locomotive. A crane, however, is quite necessary for the lifting of certain electric parts such as motors, transformers, phase converters, rheostats, and other heavy parts from the frames either through an opening cut in the roof of the cab, or after the cab has been removed. Under the crane should be provided a well lighted working pit, supplied with a suitable drop pit for driving wheels, removing main motors, truck, brake rigging work and similar work on the running gear.

There are many tools in use in the steam locomotive repair shop that might be well utilized in the maintenance of electric equipment, although on account of some of the electrical apparatus being rather special, there may be a demand for a greater number of small tools of special arrangement and design in order to handle small parts of motors, switches, blowers, etc. For instance, a boring mill for driving wheel centers and tire work, a lathe of sufficient size to swing the largest armatures or motors, small as well as intermediate size lathes, a radial drill press, a vertical drill press, a horizontal boring machine, a planer, a shaper and a driving wheel press should be provided. Lathes ordinarily used for piston work can be used for small motor shaft work. The smaller lathes and shapers can be used on a quantity of smaller electrical parts; maintenance of air compressors, dynamos, air brake work and other auxiliary units forming a part of the electric locomotive.

In addition to the equipment usually found in a well equipped locomotive shop, facilities must be added for armature banding, coil winding, press for handling armature shafts, etc. The armature and control repair department should, if possible, be conveniently located adjacent to the machine shop in order to make the best use of the crane service and minimize the re-handling of motors and especially armatures on motors.

As a rule, existing steam locomotive shops, with some slight rearrangement of facilities, are very adaptable for the care of electric locomotives. There are, however, great possibilities for economies in labor and time where new shops are designed for the exclusive care of electric equipment. A definite layout or

complement of tools cannot be prescribed, as both depend entirely upon the general design of equipment used.

Electrification progress

Progress made in the electric traction field during the past year was included as Exhibit No. 4. The new types of motive power units built were commented on and a large table included which lists electric traction installations used in all the principal countries of the world. This table includes a group of pertinent facts which characterize each installation.

A report listed as Exhibit 5 compares the relative advantages of the multiple unit system and electric locomotives for passenger service.

On motion, the report was accepted and the committee continued.

Committee on car construction

In connection with this report, attention is directed to the samples of cars and car equipment, displayed to illustrate features included therein.

The various subcommittees have done excellent work, especially that on box cars with wood sheathing and lining, and that on fundamental design calculations. The last mentioned report could not be condensed without loss of valuable information, for which reason it is included complete, as an appendix to this report.

Standards and alternates

For the purpose of simplification, and to avoid misunderstandings it was decided that only one design of complete unit or detail, not patented, if possible, would be used to illustrate a standard or recommended practice. Any other designs, either shown or implied, would be known as acceptable alternates.

A note will be included with the drawings or specifications for same to govern cars built from the design, reading as follows:

Anything that is shown on the drawings as alternates, indicates that such alternate is equal to that shown, as standard or recommended practice, in strength, service, and interchangeability, and, therefore, acceptable.

It is to be understood that the committee designs establish fixed conditions, permitting the use of detailed designs standardized by the association, or the substitution of other parts preferred by the individual railroad, singly or in groups, provided these parts, or groups of parts, are the equivalent in strength, service, and safety of, and interchangeable with, the standard part or group of parts replaced.

The subcommittee on Car Designs have adopted rules governing the size and marking of tracings which will be followed in the future.

Trucks

The general plans show the frames adopted as recommended practice, with minor unimportant modifications, to facilitate foundry work.

The side frames, with boxes cast integral, have been shown as representing recommended practice. The Andrews type and special box type, also cast or built-up types, which will meet design and specification requirements and are interchangeable, are acceptable alternates. The special box types have been previously shown, but new tracings, incorporating the slight modifications for foundry practice, made in the integral box type frames, will be made for the manual.

The bolsters illustrated conform closely to those now in the manual and to the present A. R. A. fundamentals. Other bolsters meeting the design and test requirements are acceptable, if interchangeable.

The bolsters now in the manual do not conform to the standard fundamentals, which makes them obsolete. It is, therefore, recommended that they be withdrawn, and the new bolsters substituted therefor.

The subcommittee on Trucks is investigating what changes are required in the standard arch bar design, to meet the design and specification requirements referred to.

To provide truck frame information, as complete as possible, a subcommittee on Frame Tests is preparing to test A. R. A. and U. S. R. A. frames in three ways: First, on screw-operated static test machines, with both vertical and transverse loads, in conformity with the proposed specifications; second, on the American Steel Foundries Company dynamic test plant, and, third, on the Symington dynamic test plant. It is expected that a summary of these tests, and an analysis thereof, can be presented next year.

Designs for standard cars

Single-Sheathed Cars—These designs, including specific modifications, were adopted as recommended practice. New tracings are being prepared to include the modifications, and will be available later in a supplement to the manual.

Steel-Sheathed Cars with Wood Lining—The committee was instructed to await service results of those already built before resubmitting this to letter ballot. Nothing further has been done with this design.

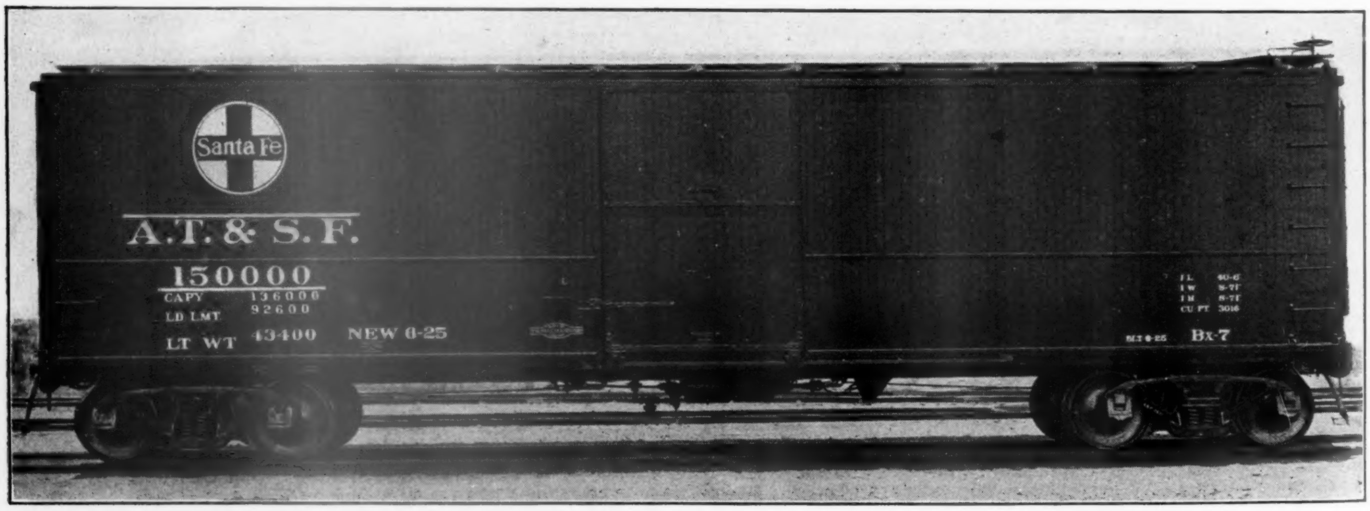
Steel Frame Cars with Wood Sheathing and Lining—These designs, covering cars of 40 and 50 tons capacity, have been carefully considered by a subcommittee, and are presented for adoption as recommended practice.

These designs include the changes in the original fundamentals, which were adopted by letter ballot vote on the single sheathed car. The fundamentals and general specifications for A. R. A. box cars, as shown in the manual, have been observed throughout.

1—In accord with the modifications adopted by the association for the single sheathed car, the length over striking castings has been reduced from 42 ft. 6 in. to 42 ft. 3 in. This was done in order to avoid having an excessive end ladder clearance when a pressed end is used, and reduces the truck centers from 32 ft. 6 in. to 32 ft. 3 in., with a consequent reduction of ¾ in. in the width of each truss panel.

2—As recommended by the subcommittee on Fundamentals of Design, the crossbearers have been relocated at the door posts, instead of at the intermediate posts.

3—A combined striking casting and front draft lug has been designed to replace these two details. This results in a saving of 6½ in. in length of center sills.



Double wood sheathed 40-ton box car, class 4C-XM2, with proposed standard lettering and marking

4—A new corner construction has been developed for this car, using a 3⅛ in. by 4$\frac{1}{16}$ in. by 3⅛ in. Z-bar for corner posts. This construction permits of the use of either the A. R. A. standard steel plate end or a pressed end, with the same corner post. The pressed end construction with its constituent parts, i.e., end sheets, end plate, side and end plate construction, end sill and push-pole pocket, taken as a group, is interchangeable with the A. R. A. end plate.

5—In order to avoid cramping the hand brake rod where it passes through the bolster diaphragms, it was necessary to redesign the body side bearing brace so that the hole for rod could be moved further from center of car. A casting was substituted for the pressing shown for single sheathed car.

6—The design of the side door has been changed to give more substantial construction.

7—A door track has been added to bring the roller more clearly over the center of gravity of the door. This track is a 1¾ in. by 1¾ in. by 1¼ in. by 1¾ in. Z-bar and serves also as a guide. A bottom supported door can be used without disturbing this top guide, and the bottom guides and the side sill filler supports are so arranged that the track for the bottom supported door can be applied without any additional punching of holes in the side sill.

8—In order to increase the ease of operation, the door hanger has been redesigned, using a 3½ in. instead of a 2½ in. roller.

9—The latitudinal running board supports have been redesigned so that the same support can now be used with either the outside metal roof or the all-steel roof.

10—Due to the location of crossbearer at the door post, it was necessary to change the brake arrangement. The cylinder and reservoir were moved 3 in. toward the center line of car. Various details were also simplified. The K D type of brake arrangement has not yet been developed.

11—The brake shaft was lengthened about 1 in. in order to give 5½ in. hand wheel clearance.

Consideration was given to all suggestions and criticisms received from nearly all members of the Committee on Car Construction, and also from the Railway Car Manufacturers' Association.

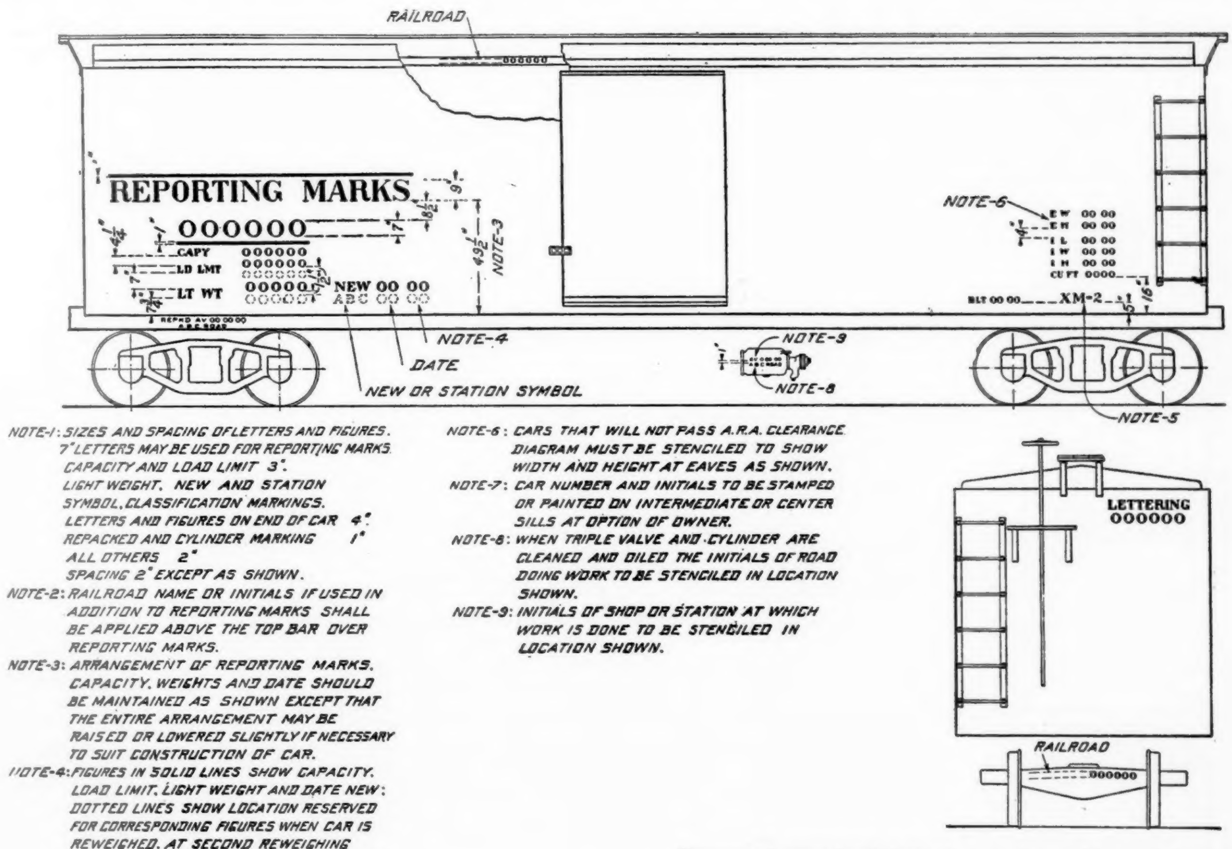
While it has not been practicable to use a number of details of the single-sheathed car on the double-sheathed cars, new details have been developed which may be used on both designs.

We wish to call attention to the method of making the post and brace connections at the side plate. The outer legs of the Z-bar post and brace are turned toward each other, and a plate is riveted on the inside, the rivets being countersunk on the outside to give a smooth surface for the application of the sheathing. The outer legs of the post and brace are riveted to the gusset plate which is flanged at the top, and riveted to the horizontal web of the side plate, instead of to the vertical leg. With this construction, the Howe truss, which is an alternate, may be applied without any interference with the carlines on the outside metal roof. This construction also tends to eliminate the eccentricity in the posts.

The subcommittee will prepare a Safety Appliance drawing for publication in the Manual after the Interstate Commerce Commission representatives have had an opportunity to inspect the sample cars and criticise the application of safety appliances. Any suggestions the Commission may make can then be incorporated in the drawing.

Fundamental calculations

In the absence of reliable information covering strains or stresses exerted on cars, and methods of calculation to design parts to resist such strain in the car body, it was deemed desirable to appoint a subcommittee of experts in this work to furnish a complete synopsis for our future guidance. This subcommittee, after a large amount of very painstaking and careful work, has produced a valuable addition to the available information on car design. Their report is given in an appendix.



Proposed standard lettering and marking of box cars

Specification fundamentals

One of the functions of the committee on Car Construction is to indicate fundamentals on which specifications should be prepared. The trucks and other important car parts can best be safeguarded by specific designs and tests predicated on standard fundamentals. The test should prove the correctness of the design.

This committee will, from time to time, present for approval such design and test requirements, and now submit for adoption as Recommended Practice, Design and Test Requirements for Truck Side Frames and Bolsters, also Coupler Yokes. These have been fully discussed with the representatives of the manufacturers.

It is recommended that, after the adoption of these requirements, the committee on Specifications and Tests be instructed to prepare the necessary detail specifications.

Side Frames and Bolsters—They may be either integral or built-up. The maximum combined unit stress in the design shall not exceed 16,000 lb. per sq. in. The basis of design shall be one axle capacity=C.

For each side frame the vertical design load shall be taken as acting on the spring base (or its equivalent, for test) and shall be 1½C. The transverse load shall be taken as acting on the bolster guides—one-half on each guide—on a line located above the normal center line through the two axles, an amount equal to the journal diameter of axle less 1½ in., and shall be 0.4C.

For each bolster the vertical load shall be taken as acting on the center line of the bolster, anywhere within 8 in. each side of the center bolster; also anywhere from the center of spring support to a point 23 in. from the center of bolster. The section moduli shall decrease uniformly from the section 8 in. from the center to the section 23 in. from the center of bolster.

The transverse load shall be taken as acting on the neutral axis (or, for test, on a line 5 in. below the center plate bearing face), and shall be applied only at the center of bolster.

For calculation of maximum combined unit stress, the vertical load shall be equal to P, as given in the table, and the transverse load shall be 0.25P.

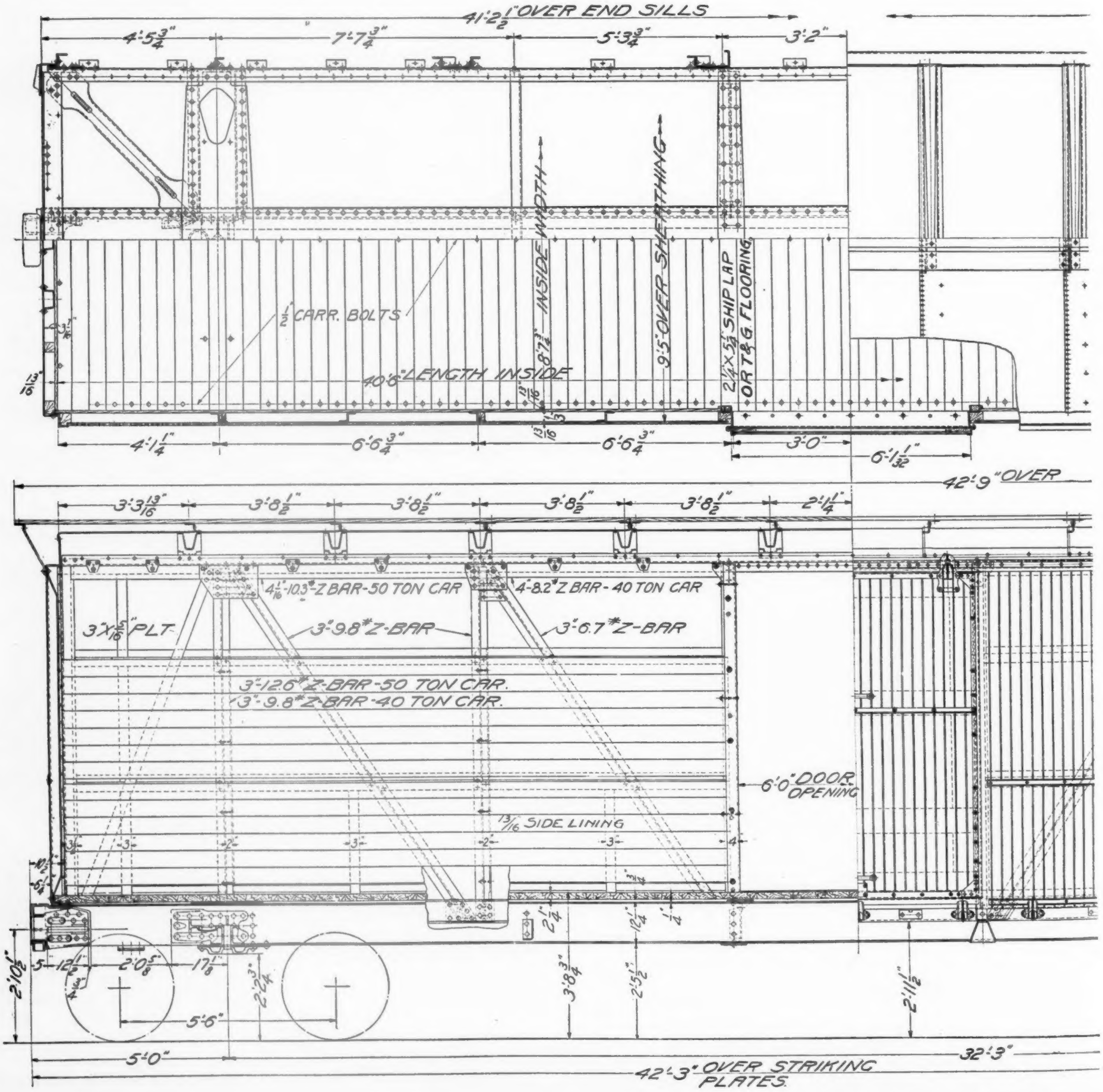
The maximum unit stress for vertical or transverse loads, considered separately, shall not exceed 12,500 lb. per sq. in. for vertical load=P, or horizontal load=0.8P.

The values for P are as follows:

Truck	P
2C	62,000
2D	77,000
2E	96,000
2F	115,000

Test load requirements

	Side Frame		Bolsters	
	Vertical lb.	Transverse lb.	Vertical lb.	Transverse lb.
Initial load or zero reading........	5,000	5,000	5,000	5,000
Load at 0.063 in. max. deflection...	2.25C			
Load at 0.075 in. max. deflection...			1.5P	1.00P
Load at 0.094 in. max. deflection...		0.60C		
Load at 0.031 in. max. permanent set	4.50C	1.20C	3.0P	2.00P
Minimum breaking load	9.00C		6.0P	



General drawing of proposed standard A. R. A.

Bolsters shall be accepted if the minimum breaking load exceeds 90 per cent of the tabulated amount.

The vertical loads, "P," for bolster, shall be applied separately, at center plate, and at side bearing.

The deflection measuring instrument shall be located midway between supports of specimen, and shall be set at zero, under initial load.

Coupler Yokes—They shall be made of cast, forged, or rolled steel. Each coupler yoke design, intended for use with type "D" coupler and 6 in. by 1½ in. key, shall meet the following design requirements and tests: If made of Grade "A" cast steel, or its equivalent, the tension area shall not be less than 12 sq. in.; and, if made of Grade "B" cast steel, or its equivalent, the tension area shall not be less than 10½ sq. in. The method of support and loading shall be equivalent to service conditions on tangent track. The maximum set shall not exceed 0.031 in. under a load of 325,000 lb., and the breaking load shall not be less than 550,000 lb. The set shall be taken in the length, from the rear follower bearing face to the front coupler key face. At least two specimens of each new design of coupler yoke shall be tested on a static testing machine.

All standard fundamental A. R. A. requirements not specifically mentioned herein shall also govern.

Truck Springs—Many serious complaints have been made as to spring troubles. The cause of the trouble is due to spring manufacture practices. These practices will have to be revised, at least to some extent. A large proportion of springs examined by micro-photography show decarbonization, on the surface of the wire, to a marked extent, indicating overheating in manufacture. The low stress in springs, when solid, evidently permitted these detrimental practices to develop. Springs properly made can readily be stressed from 25 per cent to 50 per cent higher than according to present practice.

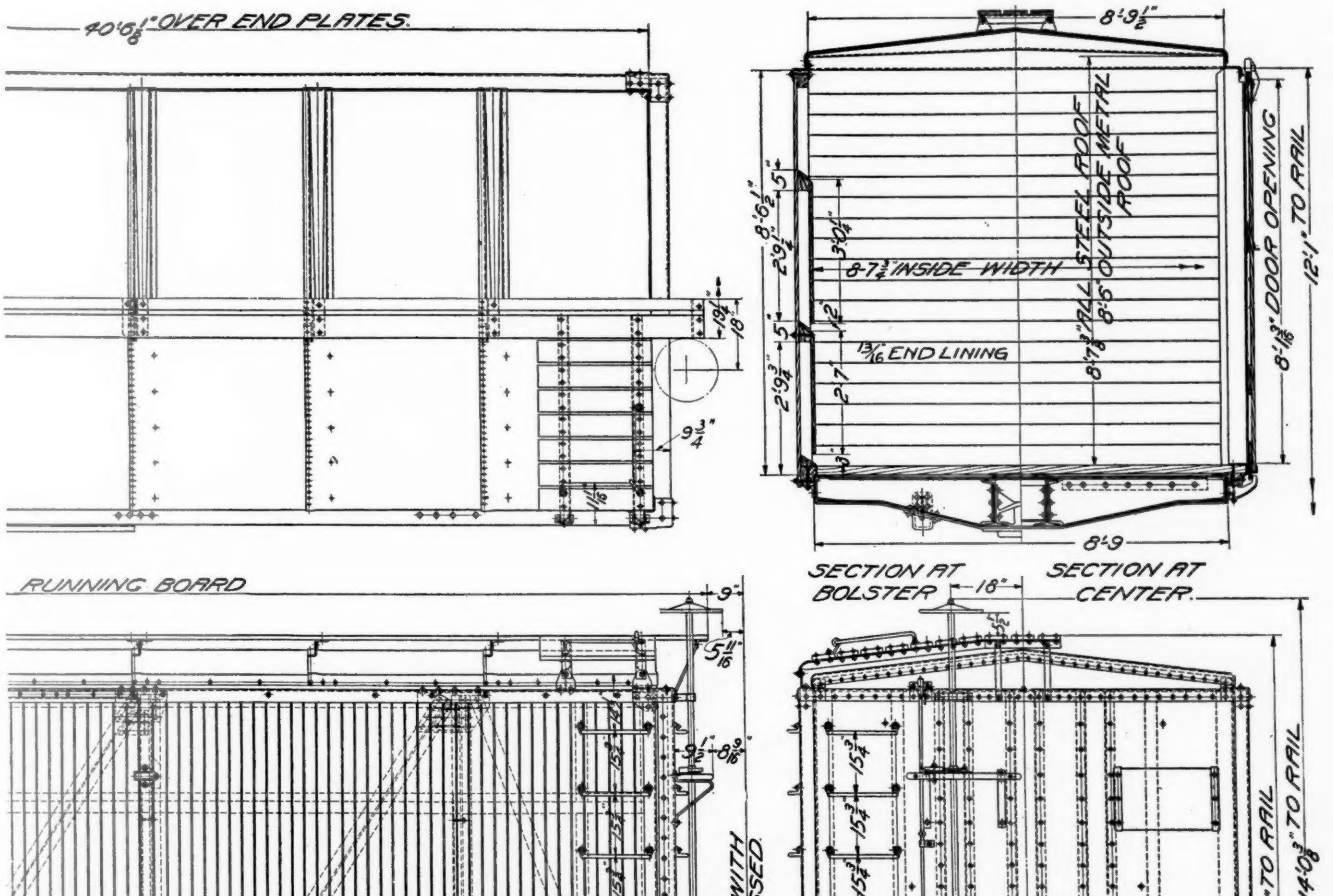
It is unanimously recommended that:

1—The tentative spring designs, class L, M, N, O and P, shown on pages 34 and 35, section D, of the manual, shall be substituted for the present standards shown on pages 27-37, in section D.

2—The tentative specifications for Chrome Molybdenum alloy steel helical springs shall be withdrawn.

3—The standard specifications for carbon steel bars for railway springs shall be modified to require free height not to exceed, and the height under specified load, not to be less than the design heights.

4—The substitution of the present standard 50-ton car springs, as shown



A. double wood sheathed box cars, classes 4C-XM2 and 4D-XM2

on page 32, section D, of the manual for springs of the new standard 40-ton cars, shall be permitted.

The changes involved in the recommended modifications will make no changes in existing trucks, will incur no increase of stress in the springs under static load, will require no different material either in quality or dimensions; but will materially decrease shock effect, thereby benefiting both the springs and truck frames.

It is recommended that, after the adoption of the above, by letter ballot, when it is referred to the Committee on Specifications and Tests, to prepare the necessary change in the specifications, they should, if possible, include a surface decarbonization limit, and such other photo-micrograph requirements that they deem proper to insure careful heat treatment.

Hatch Covers for Refrigerator Cars—It has been suggested that considerable expense could be avoided if a standard hatch cover be adopted, and all new cars be made to use that standard. A subcommittee made a full investigation of existing cars, and reported that it would be practical to adopt one standard. They submitted a design of hatch opening and cover advising that this design is adaptable to the greatest number of existing cars, without serious modification to the cars, and will be satisfactory for new equipment. Your committee recommends the adoption of this design as a standard of the association.

Corrections.—Attention was directed to an apparent error in dimensions for the gages for the 4¼ in. by 8 in. bearings and wedges. The criticism is justified, and corrections should be made.

box car ends which meet the A. R. A. requirements of section "C," pages 7 and 8, are not as serviceable as they should be; also that comparing ends on the basis of section moduli is not a measure of relative service value, on account of differences in elasticity.

During the coming year a subcommittee will make a thorough investigation of this subject by making a series of tests to destruction of the generally used corrugated ends, and the A. R. A. steel end with vertical posts. The preliminary instructions to the subcommittee include:

1—All tests shall be made on full-size samples, exactly as applied to a car.

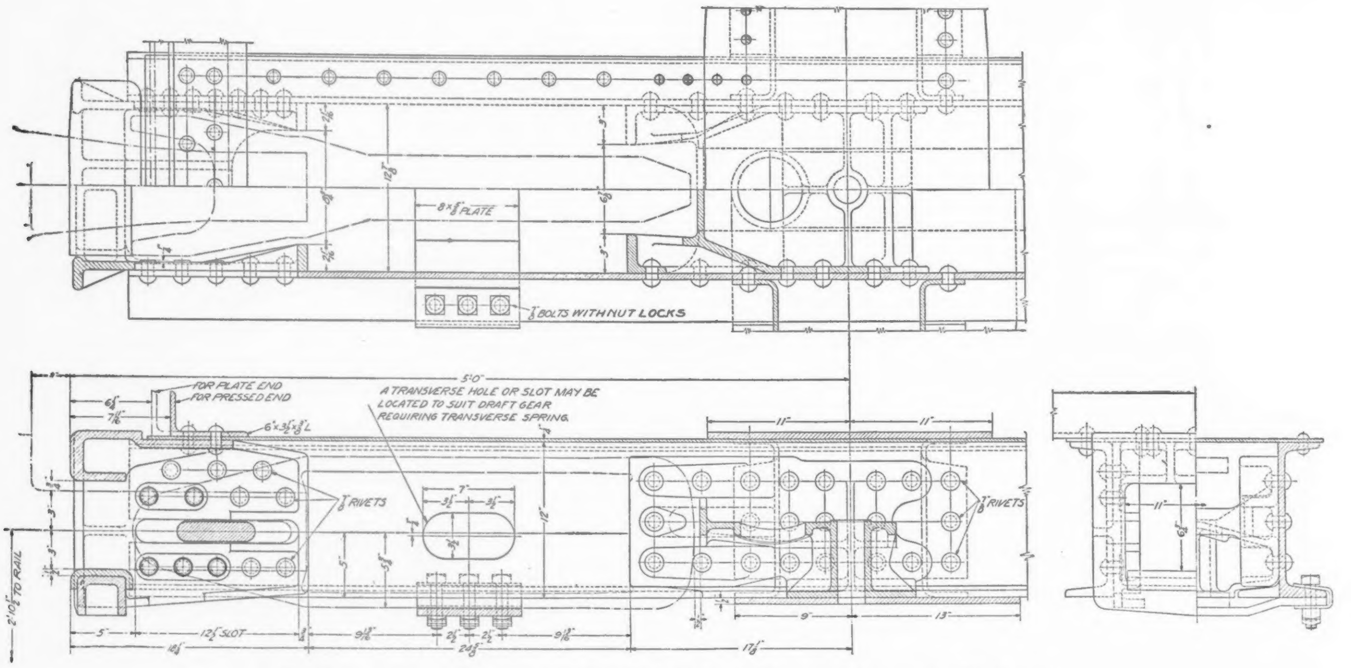
2—Ends to be tested shall be the Murphy corrugated end, and the A. R. A. steel plate end with vertical posts.

3—Ends to be tested shall include the lining and side post construction.

4—The side post construction shall be the same as used on the car, and so reinforced that these posts are not subject to material deflection.

Axles—It was requested that the non-standard axles having 4 in. by 7 in. and 4½ in. by 8 in. journals be recalculated on the basis of the A. R. A. formulæ, to determine whether the nominal capacity can be increased. This calculation showed that the axle with 4 in. by 7 in. journals, under a car with a load limit of 87,000 lb., would produce a stress of 29,520 lb. per sq. in., at the hub section. Therefore, the load limit should not exceed 67,000 lb., to meet the unit stress limit of 22,000 lb. per sq. in. For this axle no change is recommended.

The recalculation for the axle with 4½ in. by 8 in. journals,



Draft gear arrangement with combined striking casting and draft lug

We, therefore, recommend the following changes: Section D, page 25, wedge "B," change dimension "D" from 2 11/32 in. to 2⅜ in., and dimension "N" from 4 1/16 in. to 4 3/32 in. Section "B," page 23, wedge "B," change dimension "D" from 2 11/32 in. to 2⅜ in., and dimension "N" from 4 1/16 in. to 4 3/32 in.

There is a similar discrepancy in journal bearing gage, section "B," page 22, for class "F" bearing. The ½ in. dimension, at each end, should be changed to ⅝ in., for the "F" bearing only. We recommend that this be done.

There is a discrepancy in the dimensions of the cap for class "H" spring. To make the correction, we recommend that in section "D," page 33, cap for class "H" spring, the dimensions locating the tests be changed from 3 in. to 3 5/16 in., and that the depression for the bolt be made the same as for capacity for class "E" spring, page 35, section "D."

Gages shown on pages 17 to 21, inclusive, of section "B," of the manual, are still standard. They have been practically superseded by gages shown on page 22 and 23, of section "B," which were adopted as Recommended Practice in 1921. We recommend that the latter gages be advanced to standard, and that the old standards on pages 17 to 21, inclusive, be eliminated.

Box Cars (Progress Report)—The claim has been made that

when the minimum wheel seat diameter is increased from 5⅝ in. to 5¾ in., will meet the unit stress limitation of 22,000 lb. per sq. in. under a car load limit of 116,000 lb. It is, therefore, recommended that for this axle the minimum wheel seat diameter be increased to 5¾ in., and the load limit be 116,000 lb., for cars equipped with such axles.

Lumber for Cars—The United States Department of Commerce, by the Central Committee on Lumber Standards, has been active in producing new standards of dimensions and grading of lumber, for the purpose of eliminating waste by simplified practice. We have been requested to make our requirements for cars dovetail with their proposed standards, as far as possible. A careful review of what we need, and what the Central Committee on Lumber proposes to adopt as standard, has led to the appointment of a subcommittee to handle this subject. It was unanimously decided to instruct the subcommittee to ask for:

1—Lumber dressed to 13/16 in. thickness for lining and sheathing, and, if that cannot be obtained as standard, then request for ⅞ in. thickness (dressed), as standard.

2—Lumber, dressed on one side, 2⅜ in. thick, for flooring.

3—Lumber 2 in. nominal rough thickness, manufactured so that the greatest thickness is obtained when dressed on one side; this lumber to be used where 1⅞ in. is now specified for light flooring.

Moisture content in lumber used for cars is of primary importance, and we have been urged to provide a specification giving as low a percentage of moisture as can reasonably be expected under conditions that must be recognized, and at the same time insures the use of material which will not cause trouble from excessive shrinkage. We recommend as a requirement for lumber in car construction the following rules for percentages of moisture content in lumber at time of application to car:

Description	Not to exceed
Up to 1 in. thick	10%
Over 1 in. and up to 2 in.	12%
Over 2 in. and up to 3 in.	15%
All over 3 in.	20%

For sheathing of single sheathed cars, regardless of thickness, moisture shall not exceed 10 per cent. The moisture remaining in the lumber entering into the car shall be determined by taking as 100 per cent the weight of the test samples, after they have ceased to lose weight.

These recommendations, if carried out, will be a move in the right direction to secure better construction, and while the percentages are more liberal than some roads may wish to specify, they form a basis for trial that should develop whether further modifications are desirable and are so submitted with recommendation for adoption as Recommended Practice by letter ballot.

Malleable Iron Castings (Progress Report)—Requests have been received that we reconsider the elimination of the use of malleable iron for a number of items embodied in proposed standard car designs.

The standard A. R. A. specifications for malleable iron castings are practically obsolete, since metal produced by this process, at present, would permit minimum requirements greater than those specified.

Our rules now permit the substitution of changes in design and material for those given, provided they are equivalent in strength, service, and safety of, and interchangeable with, those replaced.

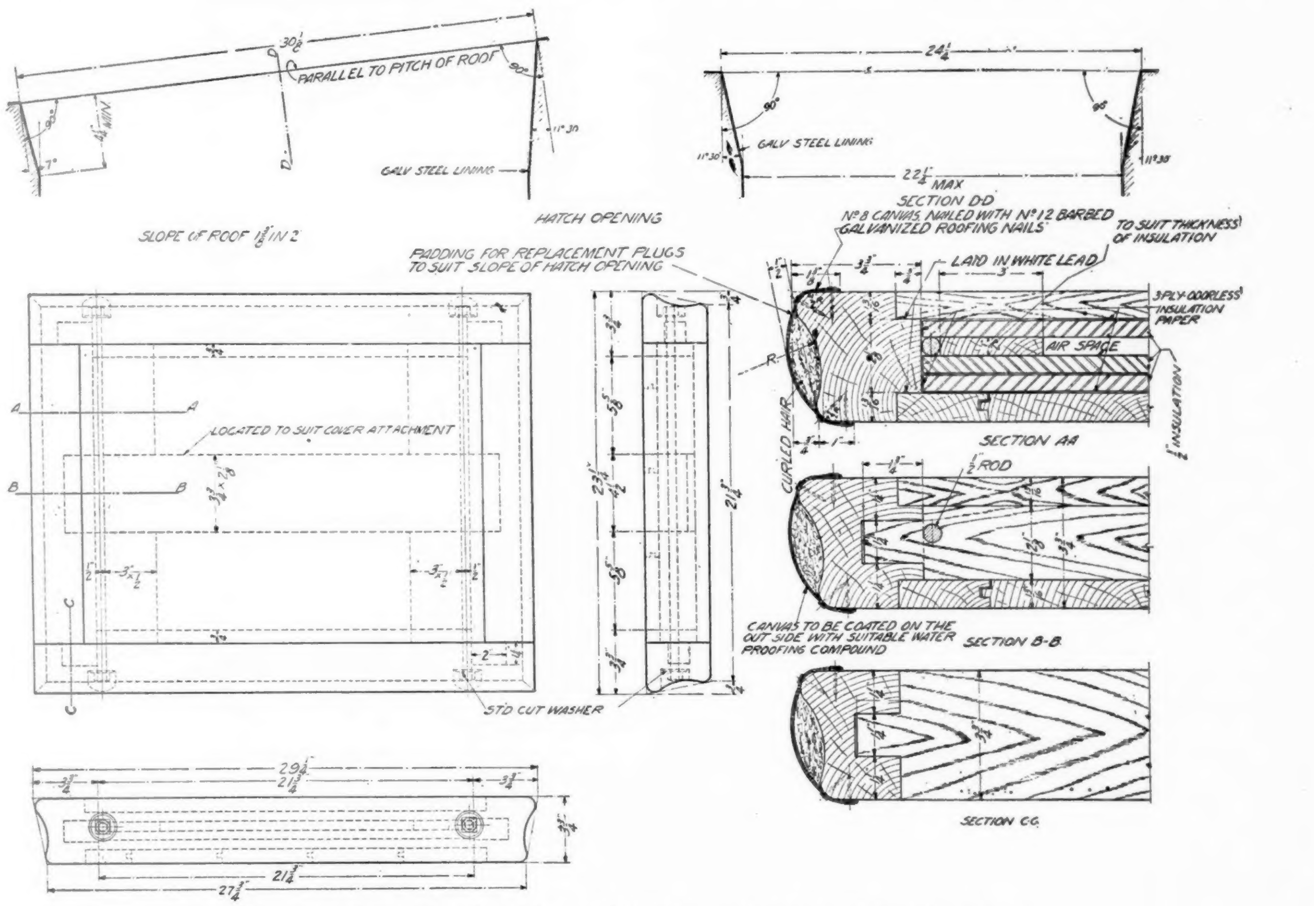
As soon as an agreement can be reached with the advocates of the more extended use of malleable iron castings, relative to the best specifications that can be formulated to govern the acceptance of such material, it is intended to indicate its value, based on the specifications, relative to steel and iron castings.

Lettering and Marking Cars—In developing designs for new cars it was noted that the present standard lettering and marking of cars as shown in the manual includes triple valves, coupler shank, coupler attachment, brake beams and size of journals, all of which parts are covered by Interchange Rule No. 3 for cars built after November 1, 1920, and it therefore appears unnecessary to include such parts in the marking of cars built after that date.

It was further suggested that the markings for length, width and height could be greatly abbreviated and that height and width at eaves would only be necessary for cars that will not pass the A. R. A. clearance diagram.

In connection with Rule 86, the Executive Committee now has before it a recommendation approved by the Transportation and Mechanical Divisions covering capacity, load limit and light weight marking in place of the former capacity and weight marking. (*See report of General Committee.*)

The committee submits with this report a drawing which embodies all of the preceding suggestions and in addition omits the railroad initials on inside of doors and adds railroad initials on inside of side plate.



Proposed standard hatch plug and hatch opening for refrigerator cars

The committee recommends the adoption of this proposed marking for:

(A) All house cars built new hereafter.

(B) For repainting house cars built new after November 1, 1920.

(C) Repainting all rebuilt cars which conform in all respects to the requirements of Interchange Rule No. 3 for new cars.

The report is signed by W. F. Kiesel, Jr. (Chairman), mechanical engineer, Pennsylvania System; A. R. Ayers (Vice-chairman), assistant general manager, New York, Chicago & St. Louis; O. S. Jackson, superintendent motive power & machinery, Union Pacific; C. L. Meister, mechanical engineer, Atlantic Coast Line; J. McMullen, superintendent car department, Erie; John Purcell, assistant to Vice-president, Atchison, Topeka & Santa

Fe; W. O. Moody, mechanical engineer, Illinois Central; J. A. Pilcher, mechanical engineer, Norfolk & Western; F. H. Hardin, chief engineer motive power and rolling stock, New York Central; C. B. Smith, mechanical engineer, Boston & Maine; S. O. Taylor, master car builder, Missouri Pacific; Ira Everett, general car inspector, Lehigh Valley; W. A. Newman, mechanical engineer, Canadian Pacific; G. S. Goodwin, mechanical engineer, Chicago, Rock Island & Pacific; F. W. Mahl, director of purchases, Southern Pacific; J. J. Tatum, superintendent Car Department, Baltimore & Ohio; L. K. Sillcox, general superintendent motive power, Chicago, Milwaukee & St. Paul.

Discussion

W. F. Kiesel, Jr. (Penna.), chairman of the Committee on Car Construction, stated that in the design for the double sheathed wood sheathed cars only one type of center sills is shown suitable for vertical yoke. It was agreed two years ago, he said, that center sills suitable for both types of yokes should be shown. In making the design for the single sheathed cars, the same center sills that are shown for the wood sheathed wood lined car and also the center sills for the horizontal yoke, which will be applicable to either one of the other cars, will be used.

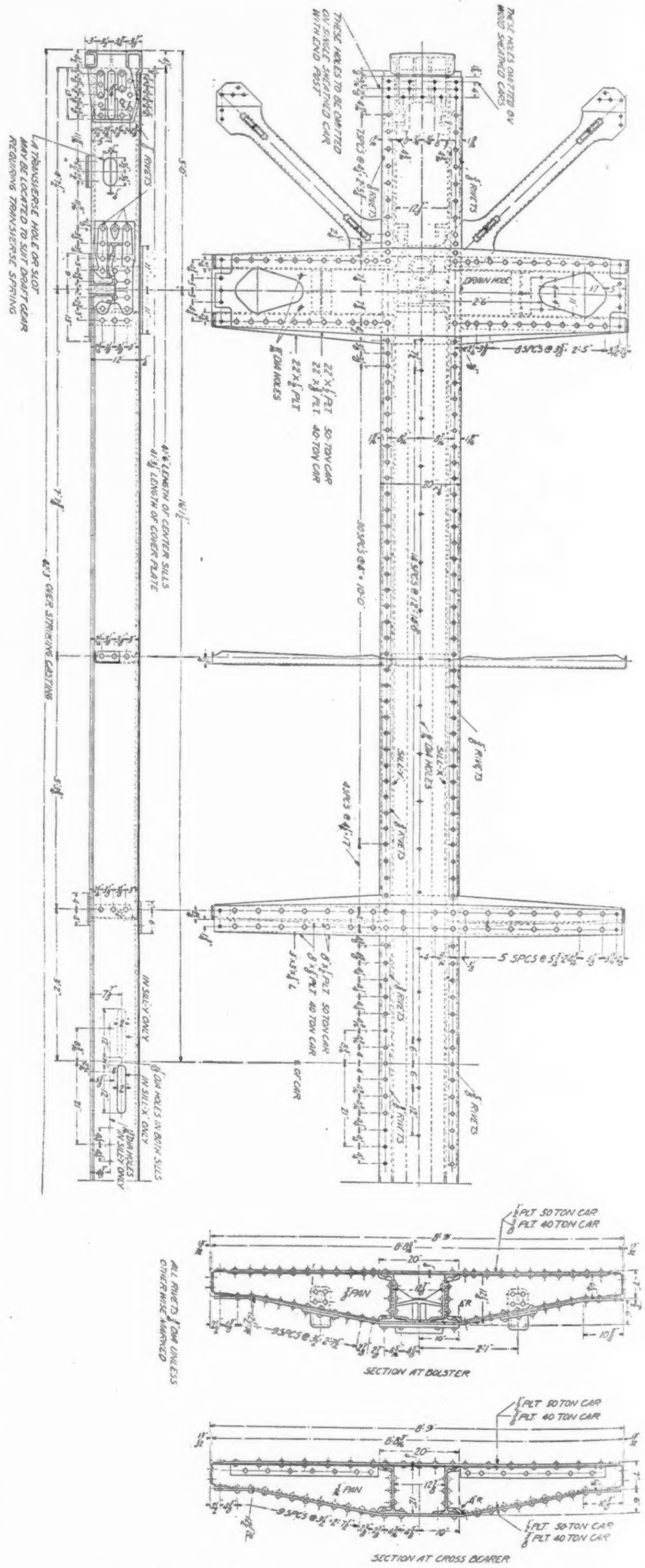
In discussing the strength of the truck frame adopted as recommended practice, J. J. Tatum (B. & O.), a member of the truck sub-committee, stated that it is planned to run comparative tests with 40-ton and 50-ton Railroad Administration side frames and with 40-ton and 50-ton A. R. A. side frames on the Symington testing machine and also on a machine which produces similar tests at the American Steel Foundries, St. Louis, Mo. To overcome the failures of the present A. R. A. arch bar truck, he said that it was thought that the truck sub-committee of the Car Construction Committee might design an arch bar that could be used in repairing the existing trucks so that the weakness of the original design could be overcome and at the same time the additional load that the new Rule 86 and the new marking permits in the car be provided for. Mr. Tatum then referred to the two B. & O. cars on exhibit during the convention, one of which is equipped with a Washburn truck and the other with a somewhat similar truck* which is free from nuts, bolts, washers, keys or pins except for brake pins.

A number of questions were asked relative to the procedure to be used in testing the side frames. It seemed to be the consensus of opinion that the standard A. R. A. static machine as well as the Symington and the American Steel Foundries testing machines should be used, and that comparative tests between the proposed arch bar truck and cast steel side frame trucks should be made.

The point was brought out that the trussed bolsters which had been used extensively on some railroads will not meet the test requirements as specified by the committee. The design with the specifications for side frames and bolsters was made so that under a combined load the maximum stress would not exceed 16,000 lb. per sq. in. This will give a factor of safety of approximately four. Under a direct vertical load it is shown in the specifications that the factor of safety is about six. It was suggested that possibly some modifications in design should be made to find whether or not trussed bolsters could not be made to meet the test limits. If not, and there was a good reason why trussed bolsters should not be subjected to the same specifications, it was stated that the committee would be glad to get any constructive criticisms and, if necessary, produce another specification that would take into account the difference in construction.

One of the speakers in discussing the design of springs recommended in the report, referred to a number of tests made at Ashtabula, Ohio, by the New York Central, with the assistance and co-operation of the Chesapeake & Ohio, the Nickel Plate, the Norfolk & Western and the American Steel Foundries. These tests were made in an effort to discover if possible just what could be expected from a spring of this design. A set of the Class *O* springs was applied to a 70-ton loaded coal car and it was found that the spring recommended as standard did not make a good showing. The Class *O* springs took an average permanent set during the test of 5/32 in. and the indications were that the springs were nearly solid under normal load. Furthermore, the rock of the car body was worse, with a single exception, than with any of the other five types of springs tested, a feature which seemed to the observers to be a serious objection. It was suggested that before the association adopts a new standard design freight car spring, it should have evidence of at least two things: first, that such a spring can be successfully manufactured, and, second, that it would prove to be a better spring than the present standard.

Mr. Kiesel, in speaking for the committee, stated that the stress for the recommended spring was increased from 80,000 lb. per sq. in. to 100,000 lb. per sq. in., thereby increasing the total possible deflection about 25 per cent and the total capacity about 25 per cent. He did not consider the rocking of the car body as a satisfactory

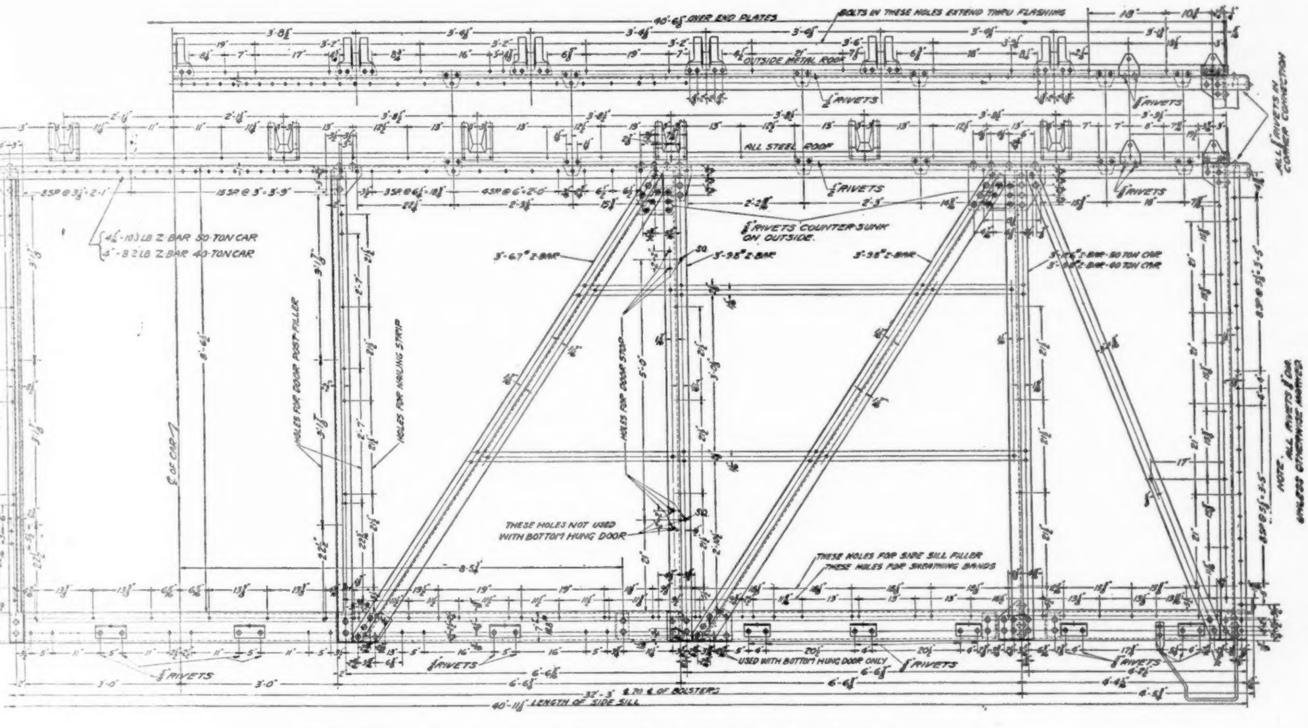


Underframe of proposed standard box cars

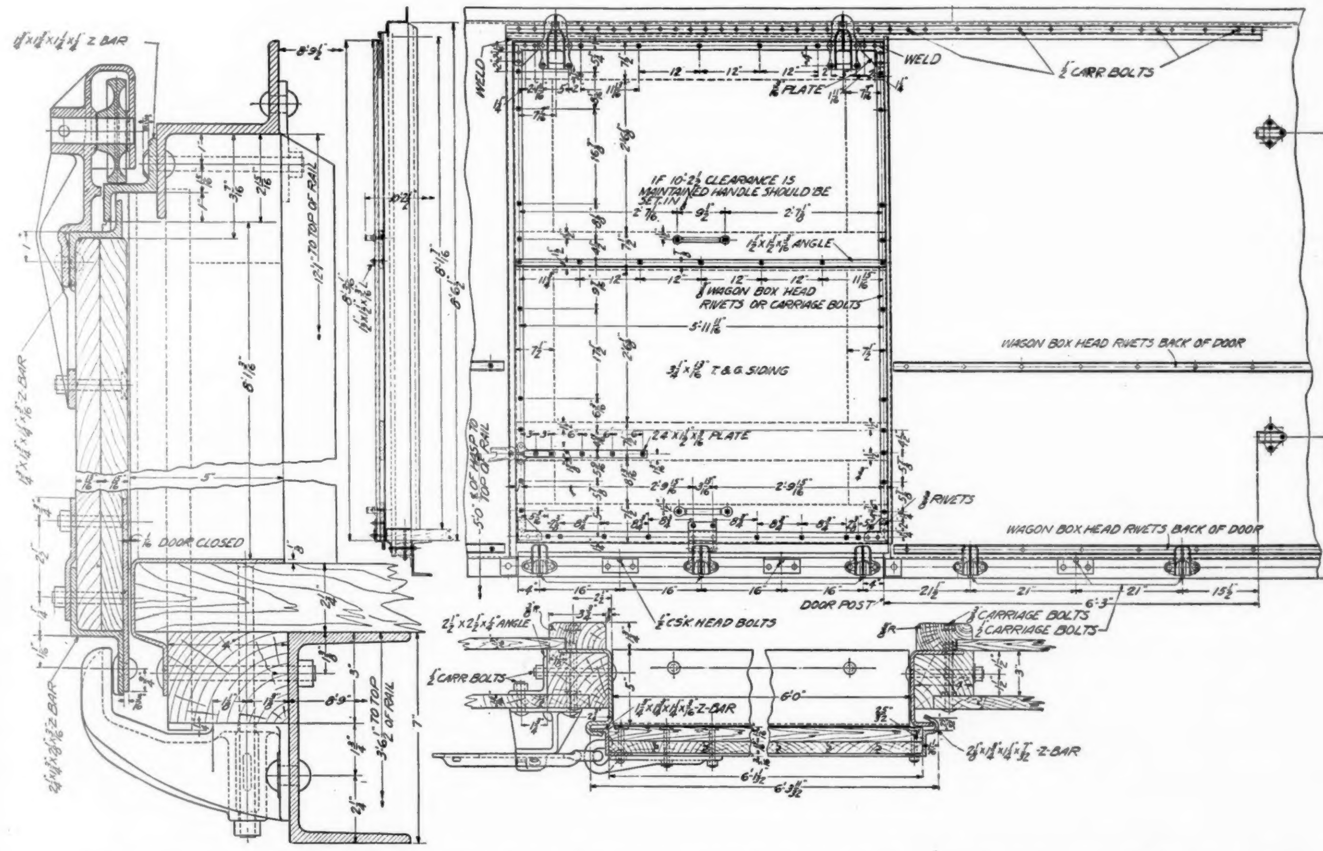
* A description of this truck will appear in a later issue.

gage of the suitability of the spring, the rocking of the car being merely an indication of the flexibility of the spring.

The question of being able to get the springs was also brought up. Some of the draft gears have springs in which the stress runs about 100,000 lb. per sq. in. and up as high as 120,000 lb. per sq. in. Such springs will cost more because the manufacturers will have to heat them more carefully. The present method of manufacture, however, will have to be eliminated. The manufacturers cannot do what they are doing now, namely, take a bar, put it in a furnace, take it out when it is white hot and the steel is almost dripping, coil it on a mandrel, dip it in the quenching fluid and pull it hot and see if it smokes, and then put in the dirt and let it draw itself.



Side framing of proposed standard double sheathed box cars



Construction of top-supported side door—Bottom-supported door can be substituted with slight changes

Considerable discussion was devoted to the practicability of substituting the present standard 50-ton car springs on the new standard 40-ton cars, and the possibility of amending the alloy

steel specifications so as to meet the new requirements. The object of eliminating the 50-ton car spring was to permit the use of springs of this type under a lower capacity car. It was the consensus of opinion that there is real need for a spring that will have a proper deflection under maximum loads.

Criticism was made relative to the inclusion of the drawings with a brake head, strut and brake beam in the set of drawings for the car but if that brake beam was necessary it should be referred to the Committee on Brake Equipment. It was suggested that the lug on the strut be marked as optional instead of as shown. The point was also brought out that this set of drawings might be made more beneficial if provisions were made to permit a more extensive application and the use of universally accepted alternates than the limited number now specifically covered thereon.

It was moved that on each principal drawing showing arrangements of draft attachments, striking castings, carrier irons and details, door arrangements, roofs and steel ends, a note be shown stating that any arrangement of draft attachments, striking castings, etc., may be used as an alternate if conforming to the general dimensions shown and approved A. R. A. specifications for strength requirements; that on the drawing showing the coupler release rigging a note be shown stating that any release rigging may be used as an alternate if conforming to the safety appliance laws and A. R. A. code; that in the drawing showing the side truss arrangement a note be shown stating that the Howe truss may be used as an alternate if conforming to the general dimensions shown; that on the drawings showing the trucks, notes be shown stating that trucks of proper capacity conforming to A. R. A. standard dimensions and strength requirements, may be used as alternates. The motion was seconded and carried.

Relative to the subject of box car ends, one of the committee reported that a manufacturer of steel ends had prepared drawings and is manufacturing at the present time a device for testing full size steel ends. The device is in the nature of a trip hammer and has a number of other advantages over types for the reason that it is portable and a blow can be struck at any portion of the steel ends desired or can be struck in a number of places without moving the end under test.

There were some objections to the upper limit of 20 per cent moisture in framing recommended by the Sub-Committee on Lumber for Cars. It was claimed that there is too much moisture to enter into framing members for new cars, particularly refrigerator cars. Dr. W. F. M. Goss read a communication from a committee of the Railway Car Manufacturers Association and a number of lumber producers in which was stated the difficulties involved in kiln-drying various types and sizes of lumber so as to conform to the upper limit recommended by the committee. The following recommendations relative to moisture requirements for lumber in car construction were made for the consideration of the members of the association:

Up to 1 in. thick	not to exceed 10 per cent.
Over 1 in. and up to 2 in.	not to exceed 12 per cent.
Over 2 in. and up to 3 in.	not to exceed 15 per cent.
All over 3 in.	not to exceed 20 per cent.

By action of the meeting the recommendations of the committee on the following subjects were submitted to letter ballot:

Substitution in the manual of bolsters shown in the report.

Proposed standard double sheathed box car.

Design and test requirements of truck side frames and bolsters and coupler yokes.

Hatch covers for refrigerator cars.

Axle.

Lettering and marking of cars (with suggested change in Note 2 of the drawing).

The following subjects were referred back to the committee for further investigation and report:

Tentative spring designs.

Moisture content in lumber.

Report of committee on tank cars

A number of designs of tank cars for special transportation purposes have been approved, the investigation of safety valves, dome covers and bottom outlet valves and connections has been extended and arrangements have been effected with the Interstate Commerce Commission whereunder the experimental application of appliances and appurtenances for tank car use will be made with the approval of the commission.

Approved designs of tank cars

1. Ethyl Chloride Cars.—Application having been made for the approval of a car for the transportation of ethyl chloride, it was determined that, since the general requirements could be satisfied with a car having the characteristics of those covered by the Class IV specifications modified to suit the particular properties of the chemical in question, the proposed cars should be built under a sub-classification of the Class IV specifications.

These cars will have heavier plates and an expansion dome with a capacity equal to four per cent of the combined capacity of the shell and dome. This dome will have a bolted cover. There will also be an additional dome comprising a cast steel nozzle riveted onto the tank proper to which is bolted a standard Class V manhole cover and dome housing and cover.

The expansion dome is provided with two safety valves. In the filling and discharge dome two 2-in. ammonia angle valves are placed, and from one of these a suction pipe leads down into a suction bowl applied in the bottom of the tank. There is no gravity outlet mechanism.

The design is covered by specifications for Class IV-A cars appearing in the report as Appendix "A."

2. Propane Car.—Designs were submitted for a Class V car for the transportation of propane, offering no departure from other cars of the same class heretofore built except that the tank is 85 in. in diameter and the car and contents are said to be heavier than the average car of similar construction now in service. The builders state that the estimated light weight of this car is 86,500 lb. and that the tank is designed for a load of 40,000 lb., or a total weight on rails of 126,500 lb.

No particular problems were presented except with respect to the braking power as to which the Committee on Brakes and Brake Equipment ruled that since the car was of a special type and the nominal braking power with the car loaded provided ample control in general service, the single cylinder 10-in. brake equipment would be accepted.

3. Dinitro-Chloro-Benzol Car.—This chemical is a non-inflammable product which liquifies at low temperature and possesses no special transportation risk. The properties of the chemical are such as to make it desirable that contact with the hands be avoided. Consequently it is desirable that the construction be such as to minimize the necessity for entering the tank. For this reason a special arrangement of heater pipes has been provided to permit the withdrawal of the pipes from the exterior of the car. This car will be built under the Class III specifications, and will be stenciled "For solids only—Pressure test not required."

4. Sulphur-Dioxide Cars.—These cars comply with the specification requirements for a Class V car and involve no peculiarities of design or construction.

5. Anhydrous Ammonia Cars.—Requirements for the transportation of this chemical are satisfied by a Class V car. The transportation of this chemical is now limited by the I. C. C. regulations to metal cylinders, and special tank cars complying with the A. R. A. specifications and having a maximum capacity of 30,000 lb. This material loaded not to exceed 0.54 lb. for each pound of water capacity. Since there appeared to be no reason for objection to shipments in larger quantities your committee offered no objection to an amendment of the regulations permitting shipments to be made in Class V tank cars.

6. Molasses Car.—The design submitted falls within the requirements for a Class III car and consists substantially of two glass-lined seamless tanks supported on steel cradles. The cradles are riveted directly to the underframe, and between the tank and the cradles 2-in. cork is provided; also between the heads of the tanks and the ends of the cradles it is proposed to apply a composition material, completely filling up the space. In general, the design follows those which have for some time been in milk transportation service.

7. Narrow Gage Cars.—In order to satisfy special requirements for restricted service, the committee gave approval for the construction of certain narrow gage tank cars having wooden underframes required for exclusive service on the Denver & Rio Grande. Approval of the construction was with the understanding that these cars were not to be offered in interchange.

Specifications

Amendments and modifications in the specifications for tank cars are recommended as follows:

1. Material.—Specifications for Class III cars, section 2.

Paragraph (b) now reads: "Rivets shall comply with the A. R. A. specifications for Boiler Rivet Steel and Rivets for Passenger and Freight Equipment Cars." This should be revised as follows: "Rivets shall comply with the A. R. A. specifications for Rivet Steel and Rivets for Steam Boilers and Other Pressure Vessels."

Question having been raised as to whether the use of cold driven rivets was permissible, it is recommended that the following sentence be added to paragraph (b) of section 2 of the Class III and IV specifications. "All rivets shall be driven hot."

2. Tank Heads.—Specifications for Class I and II cars, section 5, paragraph 3 of this section now reads: "Tank cars formerly equipped with head blocks will not be accepted in interchange after January 1, 1926, unless tank heads have been reinforced in accordance with this section." This paragraph is inconsistent with the first and fourth paragraphs of the same section and should be omitted.

3. Dome.—Specifications for Class I and II cars, section 6. Add a new paragraph to paragraph (a) as follows: "When dome cover is renewed it shall be of cast or pressed steel or malleable iron and for screw dome cover, the depth of inside ring shall be not less than 2½ in.; and suitable vents that will be opened automatically by starting the operation of removing the dome cover shall be provided." This contemplates the omission of the note appearing under paragraph (b) for a Class II car.

4. Bottom Outlet Valve.—Specifications for Class I and II cars, section 7-c, and for Class III cars, section 7-d. Add the following to the second paragraph: "Except for cars used exclusively in the transportation of asphalt or soap products and so stenciled, a valve may be attached to the outlet if it is properly capped." Also revise the note appearing in this section of the specifications to read as follows: "In no case shall the extreme projection of bottom outlet equipment extend to within 16 in. above the top of rail, except that for existing cars having fish-belly sills the extreme projection of the bottom outlet equipment may extend to within 12 in. above the top of the rail."

5. Body Bolsters.—Specifications for Class III, IV and V cars, section 11. Add the following paragraph: "For cars built after January 1, 1926, provision shall be made for jacking under the bolsters."

6. Anchorage.—Specifications for Class II cars, section 13, paragraph (a). Add the following paragraph: "As tank cars receive repairs, wooden shims interposed between the longitudinal anchorage and the underframe shall be removed and all-metal anchorage substituted, and when the construction permits the anchorage shall be riveted to the underframe. After January 1, 1928, no cars having wooden shims interposed between the longitudinal anchorage and the underframe will be accepted in interchange."

Specifications for Class III and IV cars, section 13, paragraph (a). Add following paragraph: "For cars built after January 1, 1926, the longitudinal anchorage shall be riveted to the underframe. As cars built prior to January 1, 1926, receive repairs, when the construction permits, the anchorage shall be riveted to the underframe."

7. Safety Valves.—Specifications for Class V cars, section 20. Paragraph (d) now reads: "The design of valve and its arrangement in the dome head shall be submitted for approval." It is recommended that this be modified to read as follows: "The design of valve and its arrangement in the dome head shall be submitted for approval by the Tank Car Committee. Details of approved design will be furnished to interested parties upon application." Add a new paragraph as follows: "Valve must have discharge capacity sufficient to prevent building up of pressure in tank in excess of pressure to which tank is tested."

Repairs to tanks

One of the important users of tank cars invited the attention of the committee to the desirability of establishing certain fundamental standard maintenance practices for tank car repairs covering particularly the thickness of plates to be applied for patches on tank shells and domes, and the method of application of such patches.

The committee has considered this subject of sufficient importance to warrant an investigation which contemplates a conference with tank car owners, and accordingly has delegated as a sub-committee J. T. St. Clair, A. E. Smith, George McCormick, Thomas Beaghen, Jr., and R. H. Owens.

Safety valves, dome covers and bottom outlet valves

The work in connection with these subjects is covered by reports of the sub-committees.

Investigations and tests designed to promote improvements in these parts for tank cars have now been in progress for several years, and while a number of appliances have been developed and applied for experimental purposes, with more or less satisfactory results, no definite conclusion as to a better and general type of dome cover, safety valve or outlet valve has yet been reached.

In view of the limited progress thus far made, your committee received approval of the General Committee of a joint investigation to be conducted by the A. R. A. Tank Car Committee, the tank car builders through the Association of Freight Car Manufacturers and the American Petroleum Institute. Negotiations with the two organizations mentioned are now in progress, and it is anticipated that a satisfactory arrangement will be reached whereby the three interests mentioned may jointly undertake the development of designs and the conduct of tests through an independent outside agency and thus not only insure an earlier decision as to the most desirable appliances for tank car application but remove the disadvantages and delays incident to the method now in effect. Your committee has delegated as a sub-committee to co-operate with the other parties at interest, your chairman, W. C. Lindner, chairman of sub-committee on Safety Valves and Dome Covers, and W. E. Cooper, chairman, sub-committee on Bottom Discharge Outlets.

It is hoped that at the next annual convention it may be possible to report definite progress in the solution of problems relating to tank car appliances and appurtenances which are so important in the safe transportation of inflammable liquids.

Service tests

Your committee has completed an arrangement whereunder service trials of appurtenances and appliances not covered by the specifications may proceed under authority of the Interstate Commerce Commission pursuant to the regulations for the "Transportation of Explosives and Other Dangerous Articles by Freight." This contemplates a limited number of applications of experimental dome covers, outlet valves and other appliances in order that developments in design and construction may be advanced and the perfection of these appliances thereby effected.

Report of sub-committee on dome covers and safety valves

Since the 1924 report four types of dome covers have been installed for test.

We believe that sufficient service trials of the A. R. A. Fundamental bolted type cover have been made and favorable reports of results obtained warrant the incorporation of the design in the specifications, and that it should be followed in all future applications to cars.

Since the 1924 report a test was made of six safety valves submitted by various manufacturers, as follows:

Identification Number.	Designer or Name.
1	A. R. A. Standard
2	Redcliffe
3	Beasley
4	American Car & Foundry Co.
5	American Car & Foundry Co.
6	American Car (Cooper)

It was the opinion of the committee that while valves No. 2, 3 and 6 did not function properly at the test, this was due to mechanical defects in the construction of the valves and not to the principles of design.

It was also the committee's opinion that the operation of the present A. R. A. standard safety valve could be greatly improved by having the springs checked up to see that they have the ends ground and are square to a center axis.

The test, therefore, developed that the present A. R. A. standard safety valve with a monel metal stem and a spider having a monel metal bushing (as represented in valve No. 5) gave the best results, and it was the consensus of opinion that a service test be made of the A. R. A. Standard valve with these features embodied, in addition to making the seat of monel metal.

By consent of E. A. Smith, J. O. Wilson, R. H. Owens and Thomas Beaghen, Jr., the American Car & Foundry Company, through R. H. Davenport, will, therefore, arrange to manufacture

24 of these valves to be applied to tank cars of the following ownership:

Union Tank Car Company	6 valves.
The Texas Company	6 valves.
Cosden & Company	6 valves.
Mexican Petroleum Corporation	6 valves.

Frequent observations are to be made of these valves in service, and at the expiration of a four-month period they are to be removed from the cars, boxed up without making any repairs or adjustments, and shipped to the Union Tank Car Company's plant at Whiting, Ind., where they will be tested out to ascertain their condition.

The committee is indebted to the Sinclair Refining Company for the use of their plant to conduct these tests, and also wishes to thank the various people and concerns who submitted valves for their co-operation in assisting the committee to carry out this work.

In connection with the 24 valves to be manufactured by the American Car & Foundry Company, and applied to cars of the Union Tank Car Company, the Texas Company, Cosden & Company and the Mexican Petroleum Corp., the committee is awaiting the development of these valves by the A. C. & F. Co. who are experimenting with various metals for the valve seats, and when completed a further test will be made at the American Car & Foundry Company's plant at Milton, Pa., before they are applied to cars for service trial, and in addition a number of other valves submitted by various manufacturers and inventors will be tested to determine if they have sufficient merit to warrant a service trial.

Report of sub-committee on bottom discharge outlets

Your sub-committee on Bottom Discharge Outlets has made a thorough study of all the correspondence and blue prints in its files and submits herewith summary showing the essential facts in regard to each design of valve so far submitted for approval for service trial. The valves indicated by an asterisk are locked on their seats, and from the standpoint of providing security against leakage caused by unseating of the valve by external violence are superior to the valves with which tank cars are now generally equipped.

Inasmuch as at present there are no definite specifications for the complete bottom discharge outlet of tank cars, it is essential that the tank car specifications be amended to definitely authorize the use of valves with which cars are now equipped and to provide for an improved type to be used on all new cars and for replacements on existing cars. Your sub-committee, therefore, submits for consideration the following suggestions:

(1) That Fig. 2 of the present A. R. A. Tank Car Specifications be revised to show a complete assembly of the bottom discharge outlet and its operating mechanism, corresponding to the illustration shown in the I. C. C. Regulations, and including all of the details of dimensions and wording shown on the present Fig. 2:

(2) That Section 7 of the Tank Car Specifications be amended as follows:

7. *Bottom Discharge Outlet.* (a) On tank cars built prior to 1926, if tank is provided with bottom discharge outlet the valve and its operating mechanism must conform in principle to the design in Fig. 2.

(b). Effective January 1, 1926, for new cars and replacements on existing cars, the bottom discharge outlet must conform to the following general requirements designed primarily to prevent accidental unseating of the valve under any condition incident to transportation:

1. A "V" groove must be cut (not cast) in the upper part of the outlet valve casting at a point immediately below the flange, to a depth that will leave the thickness of the casting at the root of the "V" not over ⅜ in. (See Fig. 2).

Exception.—In the case of steam jacketed outlets, groove may be omitted.

2. The flange on the outlet casting must be of a thickness which will prevent distortion of the valve seat or valve by any change in contour of the shell resulting from expansion of lading, or other usual causes, and which will insure that accidental breakage of the outlet casting will occur at or below the "V" groove.

3. The valve must have no wings or stem projecting below the "V" groove in the outlet casting, unless they are scored or designed to break or bend without unseating valve.

4. The valve must preferably be positively held on its seat by some mechanical means (other than a spring) providing sufficient strength to insure that the expansion of freezing liquid in the outlet casting will break off the outlet cap or the outlet casting without unseating the valve; to prevent displacement of the valve on its seat because of the movement of the car, vibration of the tank, or the effect of movement of liquid contents of the tank; and to prevent side lifting of the valve.

5. The valve and seat must be readily accessible or removable for repairs, including grinding.

6. The valve must not tighten on its seat under the vibratory action of the stem or rod.

7. The valve operating mechanism must have means for compensating for variation in the vertical diameter of the tank produced by expansion, weight of the liquid contents, or other usual causes, and should operate from the interior of the tank, but in the event the rod is carried through the dome, leakage must be prevented by packing in stuffing box and cap nut.

It is also preferable that the design of valve operating mechanism be such that the dome cover cannot be applied until the valve is closed.

8. The lower end of the bottom outlet casting must be tightly closed by means of a screw cap or a bolted cover, and to prevent leakage a suitable gasket must be used when necessary.

Before a bottom discharge outlet embodying these features may properly be applied to tank cars which may be used for the transportation of commodities defined as dangerous by the Interstate Commerce Commission regulations for the transportation of explosives and other dangerous articles, the design of the valve and its mechanism must be submitted to the Tank Car Committee for approval.

(c) To provide for the attachment of standard unloading connections—the bottom of the main portion of the outlet valve casting, or some fixed attachment thereto, shall have external "V" threads 5¼ in. in diameter, and a pitch of four threads to the inch. (Fig. 2).

Where a 6-in. bottom outlet valve is used the bottom outlet valve casting shall be designed to have a diameter of 8 in. over threads, and a pitch of four threads to the inch, in addition to connections as above (Fig. 2).

Cars used for the transportation of acids or other corrosive substances, or commodities which are not unloaded through the bottom outlet, if fitted with bottom outlet valve castings to facilitate cleaning of the car, need not have threads as above when designed for the use of a bolted cover.

(d) Same as in present specifications for Class III and IV tank cars as revised at the last meeting of the Tank Car Committee held April 17, 1925, with the words "bolted cover" properly inserted.

The report of the committee on tank cars is signed by A. G. Trumbull (chairman), chief mechanical engineer, Erie Railroad; J. T. St. Clair, engineer of car construction, Atchison, Topeka & Santa Fe; George McCormick, general superintendent motive power, Southern Pacific; W. C. Lindner, chief car inspector, Pennsylvania Railroad System; A. H. Oelkers, chief mechanical engineer, St. Louis-San Francisco; Col. B. W. Dunn, chief inspector, Bureau of Explosives; A. E. Smith, vice-president, Union Tank Car Company; T. H. Beaghen, Jr., Mexican Petroleum Company; R. H. Owens, master car builder, Mid-Continent Petroleum Company.

Discussion

It was stated that the committee expects to take up repairs to tank cars next year. Referring to tanks equipped with the head block anchorage, H. L. Shipman (A. T. & S. F.) mentioned the fact that there is no limit now set as to when a shoe patch should be applied to a tank head. It was suggested that the bottom of the head be reinforced by a shoe patch when it is caved in so that the surface of the tank is ½ in. below the original contour of the sheet. If a tank is deformed more than that, it is getting near the breaking strain at the flange and is liable to crack under a shifting load while being switched.

On motion the report was accepted and the recommendations of the committee ordered referred to letter ballot.

Report on brakes and brake equipment

In last year's report your committee gave some consideration to the question of brake beam safety supports, and have in the interim inspected a large number of cars equipped with such devices. This inspection developed the fact that a large variety of supports are being applied, but with few exceptions they require constant maintenance to maintain them in condition to serve the purpose for which they were applied. Those types which appear most dependable and free from necessity for frequent repair, in most cases, present some difficulty to the application and removal of brake beams without dismantling the truck. Your committee has not up to the present time developed anything satisfactory along the lines of an efficient brake beam safety support, but are continuing their efforts.

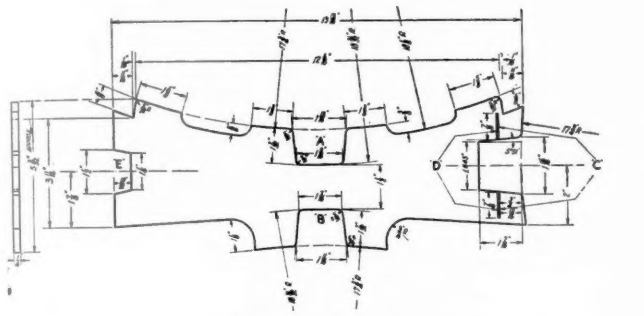
We have been requested to specify a price for brake cylinder packing other than the price now specified in Interchange Rule 101 on the basis that material of a superior quality is now available. We feel that the present price for the common brands of leather and composition packings now on the market is ample, in view of the fact that they may be procured at prices specified. We are arranging for an investigation of brake cylinder packings to determine if there is any justification for changes in Rule 101.

During 1920 your committee conducted some tests to determine if possible a standard capacity of retaining valve for freight equipment cars. Owing to the business depression following this work was not concluded. The committee has been

instructed to resume investigation of this subject and have made some preliminary tests.

During the past year your committee has completed the revision of Rules and Regulations for Testing, Inspection and Maintenance of Power Brakes. In this connection we would call attention to rule 15 (a) and (b) in the Passenger Code of Interchange Rules. This rule should be modified as follows:

Rule 15 (a) Brakes must be in perfect working order. Brake cylinders, slack adjusters, triple valves, control valves and high speed reducing valves must have been cleaned, oiled and tested within twelve months, and date



Brake shoe gage

of last cleaning and oiling stenciled with white paint in a suitable location for visual inspection. Dirt collectors and strainers must be cleaned at time of cleaning triple valves or control valves.

(b) Piston travel less than 7 in. or more than 9 in. with maximum service brake application, must be adjusted to nominally 8 in.

Classification of Rebuilt Brake Beams in order that second hand beams might be classed and charged for at the same price of new beams has been considered, however, you will appreciate that repaired beams are placed in exactly the same service as new beams, and may be expected to become subject to necessity for further repair in much less time than the latter; and the charges and credits for repaired beams we think, are ample to reimburse the railroads for such repairs. We are under the impression it would be a mistake to establish for repaired beams the same status as applies to new beams.

Brakes and brake equipment

In connection with brake beam safety supports your committee has considered brake beam troubles due to failure of hangers. The present A. R. A. brake head provides for a 1-in. brake hanger, and recently the drawings were modified to eliminate the sharp edges in the hanger groove to prevent wearing hangers, causing them to break in the corners. The committee will co-operate through a sub-committee with the Arbitration Committee who now have this subject under consideration, with a view of providing details for brake beam and brake hanger maintenance.

Suggestions for changes in graduating springs for freight triple valves has been made and we wish to advise that this matter is now in the hands of the Director of Research A. R. A. who contemplates tests of such devices. Suitable action will be taken in accordance with the information disclosed by such tests.

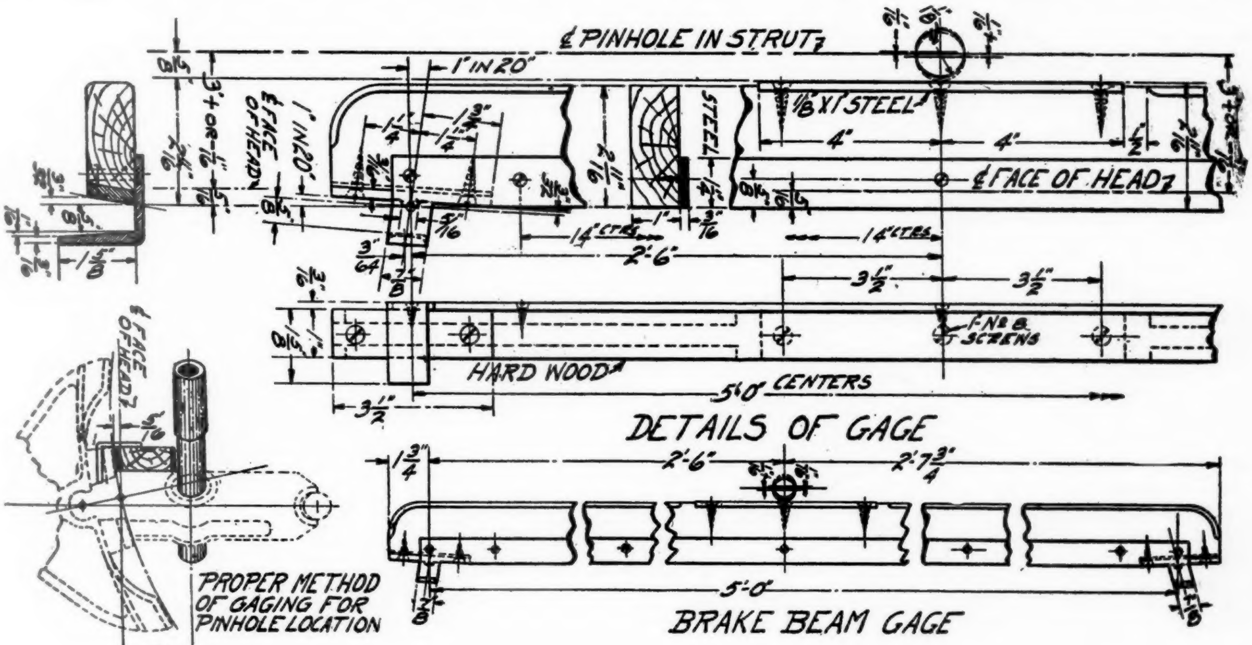
Recommendations

The 1921 report of the committee on Brake Shoe and Brake Beam Equipment contained a drawing of the A. R. A. brake beam gage, which showed several changes over the gage adopted in 1920 and which is still the A. R. A. standard. The present standard adapted itself to beams made to hang 14 11/16-in. on a 33-in. wheel when the strut was parallel to top of rail, however, the position of the present standard A. R. A. brake beam is 13 in. from center of brake head to top of rail and it will be necessary to change the dimension 2 15/32 in. from front to back of gage to 2 11/16 in., and provide a taper of 3/32 in. to that part of the gage which comes in contact with the face of the upper head lug. These changes were outlined in the 1921 report. We would, therefore, at this time recommend the changes in brake beam gage drawing shown in the A. R. A. Manual, division (B), page 7, to conform to that shown in the accompanying drawing.

We would also recommend changing the present A. R. A. brake head gage drawing shown on page 8, A. R. A. Manual, division (B), to conform to that shown below, as this gage is universally used by brake beam manufacturers because it has the advantage of more accurately gaging the entire face of the brake head, and there are no changes of dimensions which will affect the present A. R. A. standard.

An apparent weakness in the present A. R. A. brake shoe gage has been brought to our attention and we would recommend a change in the present drawing shown on page 9, A. R. A. Manual, division (B), in order to increase the dimension ¾ in. to 1½ in. and strengthen the gage at the center as shown in the drawing.

Attention has been directed to the practice of stretching springs in the spring type retaining valve, presumably for the purpose of overcoming leakage of valve seats. This trouble was more prolific when the spring type retainer first came into general use than is the case at the present time. The committee

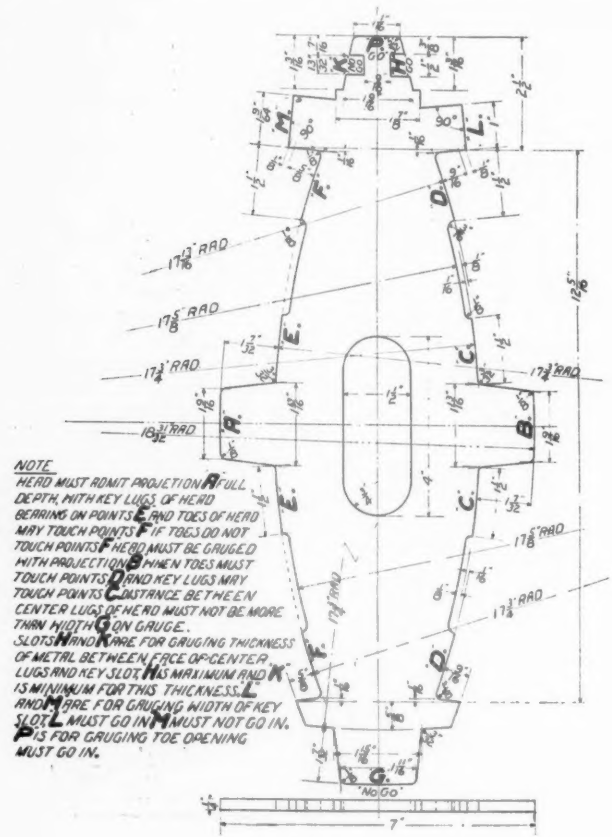


Detail drawing of brake beam gage

recommends that each road call attention of their repair men to the practice of stretching these springs and request that such practice be discontinued. Stretching the springs increases the brake cylinder pressure retained, reduces the flexibility of control and may contribute to wheel and brake shoes troubles.

Your committee recommends for letter ballot the following:

The committee's attention has been called to cases where there is an appreciable difference in the actual and nominal diameter of brake cylinders which influences the life and efficiency of brake cylinder packing on account of cylinders being considerably larger than the nominal diameter. Your committee would, therefore, recommend for adoption as recommended practice, that the



Brake head gage

actual diameter of brake cylinders for freight cars should not exceed the nominal diameter by more than 1/16 inch.

Advancing to standard the present recommended practice brake beam having central head hanging only.

This report is signed by G. H. Wood (chairman), supervisor of air brakes, Atchison, Topeka & Santa Fe; T. L. Burton, air brake engineer, New York Central; B. P. Flory, superintendent motive power, New York, Ontario & Western; J. M. Henry, general superintendent motive power, eastern region, Pennsylvania System; W. H. Clegg, chief inspector air brakes and car heating equipment, Canadian National Railways; Mark Purcell, general air brake inspector, Northern Pacific; R. B. Rasbridge, superintendent car department, Reading Company; G. E. Terwilliger, supervisor of auxiliary equipment, New York, New Haven & Hartford.

Discussion

In obtaining data for this report, it was stated that the committee inspected a large number of cars equipped with different types of brake beam safety supports and found them in all stages of disrepair. The support would be missing entirely on one truck or on one side of one truck; in some cases they were missing on both trucks. The opinion was expressed that supports riveted rigidly to the truck frame cannot be depended on and that they require too frequent maintenance to be kept in condition and the inspectors are not giving them sufficient attention.

It seemed to be the consensus of opinion that something should be done to improve the general air brake cylinder packing situation. While there are packings on the market which give much better performance than the packing provided for at the price given in the rules, the point was made that the average railroad cannot be justified in putting the higher price packing into foreign cars and getting other packing back in its own cars. It was stated that the New York Central has been operating a number of types of packings out of New York City and Chicago for practically four years. These packings are inspected periodically with a gage to determine leakage and as a result of these tests this road has been materially relieved of troubles from brake cylinder leakage.

One speaker in commenting as to the relative merits of the Wabco packing leather as compared with the leather which was formerly used for the retaining ring stated that his road had purchased a great many more of the Wabco cups for renewal than it had in previous years. However, an investigation showed that a large number of the Wabco cups had been scrapped when they were in perfectly good condition.

Attention was called to the fact that considerable difficulty is apt to be incurred in the application of the composition cup. The cup is not compressible like the other cup and unless the men handling it are cautioned, they are likely to put on the follower and tighten the nuts the same as before, with the result that the man testing out the brake gets a blow past the sleeve. He thinks it is a leaky cup and takes it off.

The opinion was expressed that rust is one of the important sources of packing cup wear. There is no question about the fact that rubber has abrasive qualities that are not present in leather. When the Wabco cup was first brought out, it seemed to be the consensus of opinion that anything in the way of grease or oil could be used to lubricate the cylinder. It was found by actual test that it was necessary to have a high grade cylinder lubricant, otherwise the cylinders would rust and cut out the cups.

The committee is seeking information as to the experience on different roads with various types of composition packing in order that it can make such recommendations as will enable the railroad to put a freight car in service and run it from one cleaning period to the other.

In discussing the subject of stencilling uncleaned triple valves, Chairman Tatum remarked that during the past year he had had brought to his attention triple valves on cars stencilled as clean, but on which the triple valves had not been cleaned. There were also instances where he had seen the dirt collectors stencilled as having been cleaned when they were not cleaned. He suggested that a rule should be framed which will cause this work to be done right or that will make it expensive to do it wrong.

The report of the committee was accepted and recommendations made therein referred to letter ballot.

Report of arbitration committee

During the year Cases 1,333 and 1,383, inclusive, have been decided and copies sent to the members. A vote of concurrence in the decisions is requested by the committee.

Considerable variance has been noticed during the past year as to the course of the procedure in submitting cases for arbitration. The fundamental principles governing this procedure are re-stated in the report. All recommendations for changes in the rules of interchange submitted by members, railroad clubs, private car owners, etc., have been considered and, where approved, changes have been recommended.

Recommended changes in the rules of interchange

Rule 2

The committee recommends that the second paragraph of Section (b) be modified as follows:

For inside door protectors, *side or end*, the car transfer check, etc.

Rule 3

The committee makes the following recommendations; that the effective date of the second paragraph of Section (b) be extended to January 1, 1927; that the effective date of the second paragraph of Section (d) be extended to January 1, 1928; that the effective date of the next to last paragraph of Section (e) be extended to January 1, 1927.

The committee recommends that the effective date of Section (i) be extended to January 1, 1927, and that the section be modified as follows:

Cars built new on or after January 1, 1927, will not be accepted

from owner unless equipped with steel underframe having a minimum cross sectional area of 24 square inches between the draft back stops.

Cars built prior to January 1, 1927, will not be accepted from owner on or after January 1, 1928, unless equipped either with steel underframe, wood or metal draft arms extending beyond the body bolster, or metal draft arms extending to metal body bolster and securely riveted to same.

The committee recommends that the effective date of the second sentence of Section (1) be extended to January 1, 1927.

RULE 4

The committee recommends that the second paragraph of this rule be changed as follows:

Defect cards shall not be required for any slight damage (new or old), that of itself does not require repairs before reloading of car, except that the car may be used, under load, in movement to shop for the required repairs.

The recommended modification is a reasonable exception to the general rule which contemplates that cars with defects requiring repairs shall not be continued in service indefinitely. The general restriction against reloading defective cars is advisable as a measure against the issuance of defect cards for unnecessary repairs.

With reference to the second sentence of the present rule, the experience has been that in many cases it is practically impossible to determine whether the defects were new or old.

RULE 9

The committee recommends that make or name should be omitted from the information to be specified on billing repair cards after item of brake beams, R & R.

RULE 17

The committee recommends that Section (e) of this rule be modified as follows:

A. R. A. No. 2 or A. R. A. No. 2 plus brake beams may be used in repairs to all freight equipment cars equipped with non-A. R. A., A. R. A. No. 1, or A. R. A. No. 2 brake beams; charges and credits to be on basis of beams applied and removed. A. R. A. No. 2 plus and A. R. A. No. 3 brake beams must be replaced in kind.

RULE 30

The committee recommends that Section (g) of this rule be modified as follows:

When a car is reweighed and remarked the car owner must be promptly notified of the old and the new weights, with place and date. The proper officer to whom these reports should be made will be designated in The Official Railway Equipment Register.

RULE 32

The committee recommends the addition of a new second paragraph to this rule to read as follows:

Steel tank heads (on tank cars), burst, except when due to inferior material, material less than required thickness, omission of reinforcing shoes where required, burned in flanging, welds or other improper workmanship; in any of such cases handling line must furnish car owner with statement showing actual condition of tank head which caused the failure.

The committee recommends that Item 4 of Section (d) of this rule be changed as follows:

No rider protection when necessary, if car is damaged to the extent shown in Rule 44. The same responsibility applies also, if car is damaged to the same extent (per Rule 44), due to defective, ineffective or inoperative hand-brake rigging, while handling car with rider protection, even though such faulty conditions may have developed during the switching operation.

The elimination of Item 4 from Section (d), and the substitution of combination factors on certain classes of tank cars to constitute handling line responsibility, as proposed by the American Petroleum Institute, is not concurred in.

The claim for this additional protection is based on the premise that tank cars comply with the tank car specifications of the American Railway Association, in some instances exceeding them, and that therefore, any damage to the sills must of necessity be the result of improper handling.

The fact that tank cars when built meet the A. R. A. tank car specifications does not of itself guarantee against subsequent failures of sills, etc., in fair service, resulting from deterioration or accumulation of strain and fatigue. Failure of buffer castings is of frequent occurrence in fair service, resulting largely from defective or inadequately maintained draft gears and coupler back stops. In this same connection, the coupler is also subject to failure although conforming to the Specifications.

The committee recognizes that under the present Rule 32 owners are obliged to assume responsibility for extensive damage to cars, some of which may have been due to improper handling, particularly by excessive impact, and, therefore, with the view of placing upon handling lines a greater measure of responsibility for the careful handling of equipment and, further, to encourage a higher standard of hand brake maintenance, the above changes are justifiable.

The committee recommends that Item 5 of Section (d) of this rule be modified as follows:

Coupling on with locomotive when first car is damaged, including damage to adjoining cars (in consecutive order) in same draft.

The committee recommends the elimination of the last paragraph of this rule as it has been covered by the second paragraph of Rule 4.

RULE 33

The committee recommends that the first paragraph of this rule be modified as follows:

Owners will be responsible for the expense of repairs to safety appliances where not involved with other delivering line damage, except on tank cars when sideswiped or cornered.

RULE 43

The committee recommends that the note under this rule be eliminated as it is covered in the new Rule 44.

The committee also recommends that the Interpretation No. 2 of this rule be eliminated on account of the new second paragraph of Rule 32.

NEW RULE 44

The committee recommends a new rule, to read as follows:

When a car is damaged to the extent shown below, if it occurred in ordinary handling, a statement must be furnished showing the circumstances under which the damage occurred in order to establish the responsibility of the car owner for the repairs. This statement, in the case of cars reported under Rule 120, to accompany request for disposition of car, and, in cases where it is not necessary to report the car under Rule 120, to accompany the bill for repairs.

(1) Six or more longitudinal sills on wooden underframe cars; however, if not more than three sills are broken new, the renewal or splicing of the remainder being necessary account of decay, elongated bolt holes or other old defects, a statement as to the existence of such old defects will be sufficient evidence of the responsibility of car owner for all repairs, providing after a thorough investigation it was not found that car was subjected to unfair handling as provided by Rule 32.

(2) Five or more longitudinal sills on composite wooden and steel underframe cars.

(3) Four or more steel longitudinal sills on steel or steel underframe cars.

(4) All longitudinal sills on all-steel underframe cars having but one steel center member.

(5) Two steel center members on tank cars having two steel longitudinal sills only.

(6) Steel tanks of tank cars shifted where secured by bolster or center anchorage.

(7) Saddle sheared from tank, or tank sheet buckled between saddle castings, or damage to both draft members on same end of car, on tank cars without center sills.

Note: Draft members, wood or steel, extending from end sill to end sill and used to reinforce center sills, are not longitudinal sills.

Reason: In view of the recognized weakness of many of the wooden underframe cars due to decay or other old defects in the sills, which are unquestionably owners' defects, and the impossibility of determining the actual circumstances under which the final failure occurs in such cases, the handling line is entitled to a greater measure of protection than is afforded under the present rule. The insertion of the note with reference to continuous draft members is considered necessary for a uniform understanding.

RULE 60

In order to prohibit the cleaning of air brakes until after the expiration of eleven months, unless car is shopped for other repairs or the air brakes are defective, the committee recommends that the second paragraph of this rule be changed as follows:

After the expiration of nine months, if car is on repair track for other repairs, the air brakes may be cleaned at same time. After the expiration of eleven months, the air brakes may be cleaned irrespective of whether car requires other repairs.

RULE 76

The committee recommends that this rule be changed as follows:

Tread worn hollow—cast iron and cast steel wheels: if the tread is worn so that projection on under side of gage does not come in contact with tread of wheel. (See Fig. 4-D), or rim liable to breakage.

Tread worn hollow—wrought steel wheels: if height of flange is 1½ inches or over, as measured with standard steel wheel gage or approved equivalent.

Note: The drawing of the standard wheel gage will be shown in the 1925 report of the Committee on Wheels.

RULE 86

The committee recommends that the wheel seat dimension for the 70,000-lb. capacity axle, shown in the table under Section (a) of this rule, be changed from 5⅝ in. to 5¾ in., as recommended by the Committee on Car Construction.

The committee recommends that standard Class "F" axles be added to the table under this rule as follows:

A	B	Limits of Wear					Dimensions, New						
Total weight on rail	Nominal capacity	C	D	E	F	H	C	D	E	F	G		H
Lb.	Lb.	In.	In.	In.	In.	In.	In.	In.	In.	In.	Ft.	In.	In.
251,000	200,000	6	7⅜	6¾	12½	¼	6½	8⅛	6⅞	12	7	8¾	⅞

The committee recommends that the second, third and fourth paragraphs of Section (b) of this rule be changed as follows:

A. R. A. Standard axle shall be used to replace non-A. R. A. Standard axles of like capacity when over-all length conforms to A. R. A. Standard, and shall also be used to replace A. R. A. Standard 60,000 lb. capacity axles having wheel seat less than condemning limit for such axle, at expense of car owner, except that in case of delivering line defects the charge against owner shall be confined to the difference in value between the non-A. R. A. Standard axle or A. R. A. Standard axle removed and the A. R. A. Standard axle applied.

Non-A. R. A. Standard axles may be used to replace non-A. R. A. Standard axles in kind, until January 1, 1928, only in such cases where A. R. A. Standard axles are not a proper substitute.

The fourth paragraph is eliminated.

RULE 91

The committee recommends that the last sentence of Section (c) of this rule be omitted, a new paragraph be added as Section (d), and that present Sections (d) and (e) become new Sections (e) and (f) respectively, as follows:

(d) If objections to bill, as per Sections (b) and (c), do not amount to $1.00 in aggregate no exception shall be taken, but bill shall be passed for payment as rendered. In any case, however, if entire bill is improperly rendered, it may be returned regardless of its amount.

RULE 98

To simplify billing transactions, the committee recommends the addition of a new paragraph to Section (g) of this rule, as follows:

The amount of service metal on both wheels will be governed by the minimum amount on either wheel, except when a defective wheel is necessarily scrapped before it reaches the limit of wear, in which case the service metal on mate wheel will be credited on basis of the actual amount.

RULE 101

The committee recommends that Items 127 and 128 of this rule be eliminated and that Items 132 and 133 be modified as follows:

Item 132: Coupler body, A. R. A., one, new, or second-hand, steel, 5 in. by 7 in. shank .... charge $9.41, credit $1.10.

Item 133: Coupler body, A. R. A., temporary standard, one new or second-hand, steel, 5 in. by 7 in. shank .... charge $10.35, credit $1.23.

RULE 104

The committee recommends that first two paragraphs of this rule be modified as follows:

Second-hand A. R. A. couplers or parts shall be charged and credited at 75 per cent of value new, except that new or second-hand coupler body, steel, 5 in. by 7 in. shank, former standard or temporary standard, shall be charged and credited at prices specified in Items 132 and 133 of Rule 101. Credits shall be confined to the body, lock, knuckle and knuckle pin, whether second-hand or scrap. In the Type D coupler, credit shall be allowed for all parts.

When new A. R. A. coupler is applied it shall be so charged whether or not it is of same make as that removed, except that where new coupler body, steel, 5 in. by 7 in. shank, former A. R. A. standard or temporary standard, is applied it shall be charged at value shown in Items 132 and 133 of Rule 101.

Passenger car rules of interchange

RULE 2

The committee recommends that the first paragraph of this rule be modified as follows:

Cars, loaded or empty, offered in interchange with defects for which owner is responsible, provided they are equipped with air brake, air signal and steam heat train line having end steam valves and otherwise meet the requirements of the receiving line as to safety and clearances, must be accepted, with the following exceptions:

RULE 7

The committee recommends that Item 4 of Section (f) of this rule be revised to conform to the recommended revision of freight car Rule 76.

RULE 8

The committee recommends that Section (c) of this rule be modified as follows:

Cast-iron wheels in place of cast-steel, wrought-steel or steel-tired wheels; cast-steel wheels in place of wrought-steel or steel-tired wheels; steel-tired wheels in place of wrought-steel wheels.

The members of the committee are T. W. Demarest (chairman), Penna.; F. W. Brazier, N. Y. C.; J. Coleman, Canadian National; W. H. Fetner, M. P.; J. J. Hennessey, C. M. & St. P.; J. E. O'Brien, Seaboard Air Line; H. L. Shipman, A. T. & S. F., and G. F. Laughlin, Armour Car Lines.

Discussion

The discussion of this report was very brief as it dealt only with the withdrawal of two recommendations made by the committee. It was decided to withdraw the recommendation for the change in Rule 17 and with reference to Rule 32, Item 4, Section (d), the committee decided to cross out the word "ineffective" because of the possibility that the word may be misconstrued.

The report was accepted as presented.

Prices for labor and materials

The committee submitted the following report under A. R. A. Interchange Rules 101, 107, 111 and 112 and the freight car code Rule 22.

Prices for materials—Rule 101

New prices are provided for reinforced doors on automobile and refrigerator cars. Items 125 and 128 are eliminated and items 132 and 133 changed at the suggestion of the Arbitration Committee.

To discourage the practice of cars being held out of service awaiting receipt of friction gears from the owners, and to facilitate the preparation and checking of bills, the committee has recommended a proposed addition to Rule 101. The new prices proposed are to be charged for various friction draft gears applied new complete, when necessary to apply complete gear on account of any or all parts of old gear becoming defective. In conformity with Rule 88, one type of gear may be substituted for another if the type substituted conforms to the one removed as to sill spacing and coupler pocket limits. In such substitution complete gears removed shall be credited at 25 per cent of the price new, complete, when removed on account of defective friction casing or castings, and at 50 per cent of the price new, complete, when removed on account of any other part or parts of the gear being defective.

Second-hand complete friction draft gears shall be charged at 75 per cent of the price new, complete.

When new or second-hand parts of any type of friction draft gear are applied in replacement of such parts becoming defective, they should be charged at the factory prices, as new, plus 15 per cent.

New Item: 16-a—Arch bar, on trucks without column bolts and

with channels riveted to arch bars, one or all on same side, R & R or R, charge on bolt and rivet basis. Add jacking of car when necessary.

New Item: 19-a—Cylinder body, combined type (body only), charge for 8-in. $5.47, and for 10-in. $6.60.

New Item: 19-b—Cylinder, complete, detachable type (without push rod), Nos. 69817-69751, charge for 8-in. $12.32 and for 10-in. $16.80.

New Item: 19-c—Cylinder complete, combined type (without push rod), Nos. 69816-69818, charge for 8-in. $11.07 and for 10-in. $15.55.

New Item: 108-a—Brake connection, bottom, forged, hollow design, price of each $2.40; credit $0.12.

New Item: 142-a—Coupler cross key lock, U type, price for each unit $.055; credit $.005.

New Item: 156-a—Half door or twin door, reinforced type, for the side of an automobile car, price for each applied $19.00. No credit for scrap.

New Item: 156-b—Half door or twin door, right hand with fixtures, for the side of refrigerator cars, wooden, price of each applied $24.45. No credit for scrap.

New Item: 156-c—Half or twin door, left hand, for the left side of refrigerator cars, wooden, price of each applied $17.38. No credit for scrap.

Prices of labor—Rule 107 and 111

Investigations reveal that no change is warranted at this time in existing labor allowances per hour as set forth in Items 427, 442 and 443.

The report recommends several changes in the wording of items in Rule 107 to define more clearly what is included in the time allowances, some of which are changed, and the following new items are added:

New Item: 121-a—Coupler cross key lock, U type, R & R or R, when coupler cross key is not R & R or R. Ordinary refrigerator cars—3 hr.

New Item: 317-a—One end sill, flush type, on open top cars, renewed, includes R & R or R of end stakes outside of car. (No extra charge for coupler R & R or R at the same time.) Ordinary car—9 hr.

New Item: 319-a—One end sill, flush type, on open top cars, renewed when one or more defective sills are renewed or spliced, includes R & R of end stakes outside of car. Ordinary car—7 hr.

Destroyed or damaged cars—Rule 112

The committee recommends a complete revision of Rule 112 in line with the slight reductions occurring in the market prices.

The following addition has been proposed to be added to this rule: A refrigerator car is either an RA, RB, RM or RS car as defined in Section L of the A. R. A. Manual. All VS, VA, Eastman Heater and other special types of house cars should be settled for on a box car basis.

It is proposed to change, in Interchange Rule 22, the price of Pintsch gas per receiver set from $1.54 to $1.60.

The report is signed by A. C. Calkins (chairman), N. Y. C.; Ira Everett, Lehigh Valley; J. K. Watson, A. T. & S. F.; T. J. Boring, Penn.; H. H. Harvey, C. B. & Q.; H. H Boyd, Canadian Pacific; A. E. Smith, Union Tank Car Company, and M. R. Esherwood, Swift & Company.

Discussion

After the reading of the report Mr. Calkins stated that Items 179 and 187 contained allowance for refrigerator cars which should come out.

The report was adopted as presented by the committee.

Report on couplers and draft gears

In order that the subject of draft gears might be exhaustively studied, the committee recommended, under date of December 6, 1924, that the sum of $50,000 be appropriated to cover the cost of designing, building and housing a 27,000 lb. drop test machine together with the necessary recording apparatus.

This recommendation was unanimously approved by the General Committee, and the Board of Directors on March 20, 1925, authorized an appropriation of $50,000 for constructing a drop test machine as recommended. The necessary steps are being taken in arranging for the detail plans and building of this machine, determining upon the most suitable location for its installation, and erecting it, all of which under the direction of the Mechanical Division and with the supervision of the president of the Association will be brought to as speedy a conclusion as possible.

The information that will be developed by this testing machine will be of the greatest value to the railroads as strictly comparable data on the performance of draft gears of different designs, both new and after periods of wear in actual service, will be available.

From the information to be obtained, suitable specifications are to be prepared for the purpose of eventually restricting the use of draft gears to those that are known to meet the prescribed standards of efficiency and through the experiments to be conducted obtain such facts and information as will assist in the development of draft gears generally.

Couplers other than A. R. A. standard

The present specifications for purchase and acceptance of A. R. A. Standard "D" couplers, knuckles, locks and other parts make no reference to couplers of former types which are being ordered for repairs and will be required until the disappearance of cars of design not suitable for the Standard "D" coupler.

It is felt that the static and dynamic tests formerly required for M. C. B. couplers should be dispensed with and that for such types the tests need cover the quality of the material only.

To meet this situation the note now appearing under the title of the present specifications for Standard "D" couplers should be revised to read as follows:

"These specifications replace specifications for M. C. B. automatic couplers adopted in 1899. When couplers other than type 'D' are ordered under these specifications, they shall conform to the requirements for quality of steel, workmanship, and details of inspection. No tests of the couplers as a whole will be required."

It is recommended that the reissuance of this note be referred to letter ballot.

Failure of cotters securing draft gears

Attention is directed to the frequent failure of the various forms of cotters in general use for securing cross draft keys in place. These cotters are failing both on account of being worn away due to contact with the draft castings. and from being sheared off due to lateral movement of the coupler and draft key when curving.

The washers encircling the cross draft key used by some roads greatly improve the conditions resulting from wear but are of no benefit as concerns shear.

An investigation conducted by your committee shows that while the failure of these cotters is most frequent in the front cross draft key it occurs to a considerable extent in all keys. Cases have been observed of U-shaped cotters made of 5/8 in. steel being sheared off on new cars when being moved over curves.

It is proposed to cover this matter in a circular to the members as soon as it has been determined which of certain methods under consideration for correcting the trouble are most satisfactory.

Standard "D" couplers—Minor changes

In order to determine how the Standard "D" couplers and parts are standing up in service and whether any changes in the detail design should be made, the roads represented on your committee have arranged for special examination and report on each Standard "D" coupler or part requiring renewal during a period of six months.

These reports will be consolidated to show just what is taking place and should indicate clearly whether the present coupler is equal to the service conditions encountered, and whether any modifications in design should be made. The results of this investigation will be included in our report to next year's Convention.

Your committee has authorized a few changes of a minor nature in the detail designs of the standard "D" coupler and gages, none of them in any way affecting interchangeability or strength of the parts, and all of them being agreed to by your committee and the mechanical committee of the coupler manufacturers and the standard drawings on file corrected accordingly.

The report was signed by R. L. Kleine (chairman), assistant

chief of motive power, Penna.; J. R. Onderdonk, engineer of tests, B. & O.; C. J. Scudder, superintendent motive power and equipment, D. L. & W.; J. A. Pilcher, mechanical engineer, N. & W.; C. B. Young, general mechanical engineer, C. B. & Q.; Samuel Lynn, master car builder, P. & L. E.; L. P. Michael, mechanical engineer, C. & N. W.; E. A. Gilbert, general master car repairer, S. P.; and Prof. L. E. Endsley, University of Pittsburgh.

Discussion

It was pointed out during the discussion that definite plans were under way for the installation, at some accessible university, of a draft gear drop test machine. The appropriation of $50,000 for this machine was mentioned in the General Committee's report.

It is considered a waste of time to make drop tests at the manufacturers' plants on couplers of the standard design. The drop and jerk tests were design tests to protect the railroads when buying couplers of an unknown quantity. However, the railroads should be assured that the steel used in the couplers is of a proper quality.

The report was accepted and referred to letter ballot.

Report of loading rules committee

During the past year the committee has been in conference with the automobile shippers and the steel industries on the subject of Loading Rules as applied to their products. These shippers, as well as others, have placed before the committee a number of recommendations for changes and additions to the Rules. Trial shipments involving new methods of loading small diameter tanks, concrete pipe and wide plates not adequately covered by the Rules were followed through to destination in order to determine whether they were practical and safe.

As a result of its investigations the committee submits the following changes and additions to the Rules for approval and submission to letter ballot for adoption as standard of the Association.

Changes in general rules for the loading of materials on open top cars

Rule 13, First Paragraph—The width of overhanging loads placed on single cars, *when flat cars are used as idlers,*

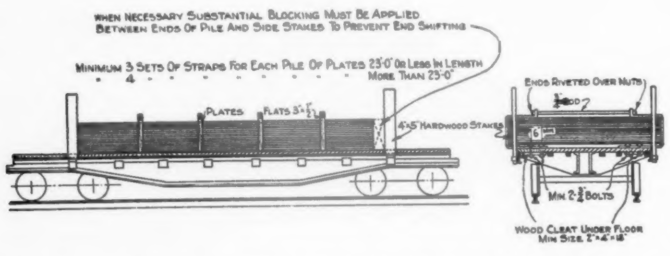


Fig. 44E—Manner of securing wide plates loaded on flat cars

must never exceed the following dimensions as a maximum and the load must be governed by the total length of lading and weight limits prescribed in table under Rule 23 for the length of car used. *When gondola cars are used as idlers see limitations prescribed in Rule* 221.

Rule 28—Bearing-pieces must never be placed between bolster and end of car, unless special provision (*See Rule* 217) is made therefor in detail instructions. (The remainder of the para graph is unchanged).

Changes in rules governing the loading of lumber, logs, ties, etc.

Rule 100—The following is added to Section B:

Height of load given is measured either from floor line of flat cars or from top of sides of gondola cars.

Section C. For loads of lumber or timber, not of equal thickness which cannot be lapped or stripped, the sizes of hardwood stakes must not be less than 4 *in. by* 4 *in.*

EXPLANATION: Sections B and C are revised to conform with the second paragraph of Rule 102.

Changes in rules governing the loading of structural material, plates, etc.

Proposed New Rule 201-A—When plates are too wide to be loaded in accordance with Rule 201 they may be loaded in accordance with Fig. 44-E. When so loaded there must be at least three tie straps, each not less than ½ in. by 3 in, to each pile of plates 23 ft. or less in length and four tie straps, each not less than ½ in. by 3 in. for each pile of plates over 23 ft. in length.

Each tie strap must be secured by not less than two ¾-in. bolts spaced at least 6 in. apart and passing through floor of car with cleats under floor 2 in. by 4 in. by 18 in. The material

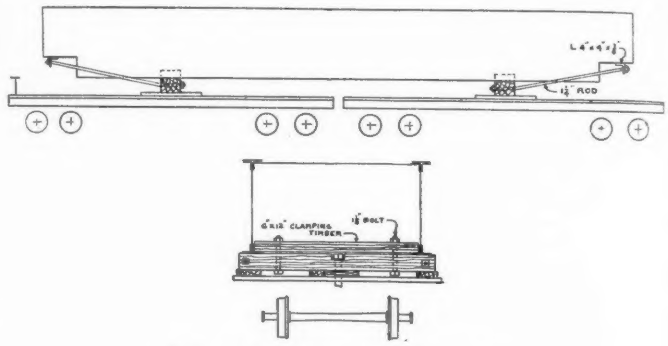


Fig. 76A—Loading of turntables

must be placed against stakes not less than 4 in. by 5 in. at one end of the car and at the opposite end two stakes not less than 4 in. by 5 in. must be placed in the nearest stake pockets to the end of the load. If there is any space between the end of the load and stakes, this space must be built up as per Fig. 44-E to prevent end shifting. Care must be taken to have the straps fit the load snugly and the tops of the clamps must be tied together by ¾-in. rods with ends riveted over nuts.

EXPLANATION: Numerous shipments have shown this method clamping to be satisfactory and it takes care of wider plates than now provided for in the rules.

Rule 203—Gondola cars loaded with plates or other material on floor of car may have plates that are too wide for the car loaded on top of car sides when height of sides does not exceed 3 ft. (See Fig. 45 or 45-A). Such superimposed plates must be supported by posts 4 in. by 6 in., one set of posts for each 6 ft. length of lading, with a minimum of three sets of posts for each tier of plates. Side motion to be prevented by not

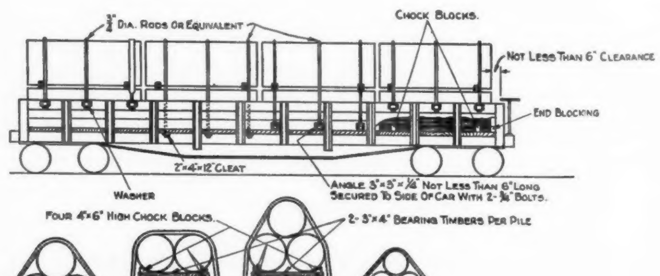


Fig. 101A—Manner of loading small diameter tanks on flat and gondola cars

less than three clamps constructed as shown in Figs. 45 or 45-A. Longitudinal motion to be prevented by *uprights,* 4 *in. by* 6 *in. bolted to side of car with ⅞-in. bolts and backed up by struts* 2 *in. by* 8 *in. spiked or bolted to sides of car.* Total weight of plates loaded in this manner must not exceed 75 per cent of the Load Weight, as per General Rule 5.

EXPLANATION: Rule revised to prevent end shifting of the plates. It was found by experience that the diagonal struts split readily when placed directly against the plates.

Rule 211—When one or both bearing-pieces are placed on the car floor they must be located over the car body-bolster or between car body-bolsters, and must never be placed between car body-bolster and end of car unless special provision (*See Rule* 217) is made therefor in detail instructions. When one or both bearing-pieces are placed on top of car sides they may be located within 12 in. either side of the center line of the freight car body-bolsters.

Rule 222—The idler used with loads as shown in Figs. 54 *and* 55 may be a low side gondola car, but must have at least 4 in. clearance vertically between load and idler body or brake shaft.

Rule 247—The bolsters may be held to the turntable in the manner shown in *Fig.* 76, or if rivet holes are available in the lower flanges, they may be held with four ¾-in. bolts at each end.

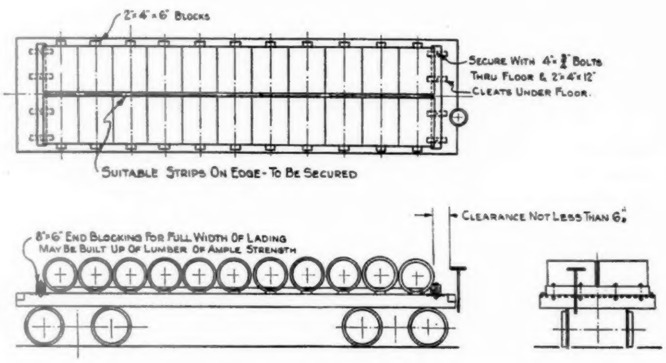


Fig. 109A—**Manner of loading concrete culvert pipe on flat cars**

Another method of securing the bolsters to the turntable by clamping to the inside flanges is shown on Fig. 76-A. When turntables of the straight girder type are loaded in this manner, rods to prevent end shifting must be applied as shown in the figure. The bolsters must be secured to the *car* by a center pin 2½ in. in diameter, passing through bolster, center-plates and top timber of cribbing *or floor of car*.

EXPLANATION: An alternate method of clamping the turntables to pivoted bolster has been provided at the request of the shippers.

Trial shipments showed this method of securing the turntable to be satisfactory.

Changes in rules governing the loading of boiler shells, machinery, etc.

Rule 302, New paragraph—Small diameter tanks, when more than one tank can be placed longitudinally (side by side) on flat or gondola cars shall be loaded as follows: Tanks weighing less than 3,500 lb. each may be loaded three, four, five or six tanks per pile, as per Fig. 101-A, Sections "B" and "A". Tanks weighing 3,500 lb. or over, must be loaded three tanks per pile as per Fig. 101-A, Section "B". Tanks loaded four, five or six per pile must be secured by three rods or bands per pile and when loaded three tanks per pile must be secured by two rods or bands, rods or bands must be secured to side of car, stake pockets or floor of car with suitable nuts and washers or cleats; threaded ends to be riveted over or checked to prevent loss of nuts. Rods must be at least ¾ in. in diameter, and bands must be of equivalent strength, with bolt ends welded on. Each layer of tanks, when not loaded in pyramidal form must be separated by at least two 3-in. by 4-in. bearing timbers having 4-in. by 6-in. chock blocks spiked to top and bottom of each bearing-timber. Side blocks on floor when loaded in gondola or flat cars, must be 4 in. wide by 6 in. high and applied as shown in Fig. 101-A for each pile of tanks, and when loaded on flat cars each block must be backed up by a 4-in. by 5-in. side stake. End blocking must be applied to other end of end piles. On gondola cars, the end blocking should be 4 in. by 4 in. spiked to floor with 60 penny spikes and on flat cars the end blocking should be 4 in. by 6 in. bolted to floor of car with four ¾-in. bolts with 2-in. by 4-in. by 12-in. cleats under floor. Tanks less than 8 ft. in length having flat ends, may be loaded on end in gondola cars, providing they are securely blocked and braced to prevent end shifting and falling over.

Changes in rules governing the loading of concrete culvert pipe, brick, stone, building tile, etc.

Rule 400—Manner of securing concrete culvert pipe loaded on flat cars: Pipe loaded on its side should be secured as per Fig. 109, 109-*A or* 109-*B, the method shown on Fig.* 109-*B to be followed for pipe loaded crosswise of car, when cars are not equipped with end stake pockets.* If loaded on end it should be secured as per Fig. 110.

EXPLANATION: New figures have been added to the rules to cover concrete culvert pipe loaded on its side crosswise of car. This method of loading is giving satisfactory results in actual service.

Rule 401, Second paragraph—Where separating strips to keep lading clear of car floor are referred to in these rules, they should be sound wood, not less than *three inches* wide by *one inch* thick. (The remainder of the paragraph is unchanged).

EXPLANATION: Thickness of bearing-strips changed from 1½ in. to 1 in. to overcome breakage of stone in transit.

Rule 417—Building tile, *unless otherwise covered by governing classification*, loaded interlocked at doorway do not require door protection if built up as per Fig. 113, and packed tight to prevent motion between tiling. (The remainder of the paragraph is unchanged).

EXPLANATION: Reference to the Classification has been incorporated in the rule to avoid confliction between the Loading Rules and Rule in the Classification covering this class of material being shipped.

Changes in rules governing the loading of automobiles

Rule 518, Paragraph (i) —*After* loading, emergency brakes should be set, *except on balloon tires, where it is optional.*

EXPLANATION: To set emergency brakes on automobiles equipped with balloon tires will damage the brake mechanism, due to the fact that constant jar in the car on account of the resiliency of the balloon tires would spread the brake bands when the brakes are set.

The report is signed by R. L. Kleine (chairman), assistant chief motive power, Penna.; R. H. Dyer, general car inspector, N. & W.; E. J. Robertson, superintendent car department, Soo Line; Samuel Lynn, master car builder, P. & L. E.; G. R. Lovejoy, master mechanic, Detroit Terminal; T. O. Sechrist, assistant superintendent machinery, L. & N.; C. J. Nelson, chief inspector, Chicago Car Interchange Bureau, and R. B. Rasbridge, superintendent car department, Reading.

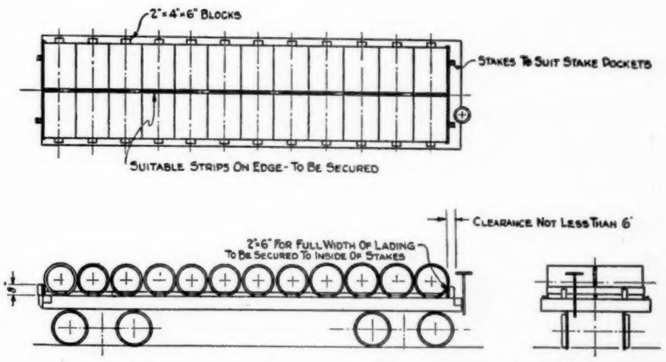


Fig. 109B—Manner of loading concrete culvert pipe on flat cars

Discussion

After presenting the report Mr. Kleine stated that the committee had a number of rules under investigation and new rules under consideration that were not completed up to the time of the convention. As the Loading Rules Committee works through the entire year, making trial loads at the request of the shippers, he asked that the members of the association consider some subsequent recommendations which the committee would make for inclusion in the letter ballot, accompanied by a full explanation.

The report was accepted subject to later changes as requested by the chairman of the committee.

Specifications and tests for materials

The report submitted by the committee recommended the withdrawal of one tentative specification, revisions of five standard specifications, revisions of eight practice specifications and the adoption of two new recommended practice specifications.

Withdrawal of specification

In 1921 the committee presented a new tentative specification for Chrome Molybdenum Alloy Steel Helical Springs. Inquiry has developed the fact that no use is being made of this specification except that one consumer had attempted to secure such springs with unsatisfactory results. The committee, therefore, recommends that this specification be withdrawn from the manual.

Revision of standard specifications

Specifications for Quenched and Tempered Carbon Steel Axles, Shafts and other Forgings, to be revised as shown. These specifications have been revised with the co-operation of the American Society of Steel Manufacturers' Committee on Axle Specifications to bring them into line with recent practice, mainly as regards form, and also to revise the section on proof tests. In the proposed modified form the two classes formerly called first class and second class according to size are changed to class A and class B. In the chemical composition the carbon content is increased slightly in class A. A change is made in the method of determining the elastic limit and the section relative to proof test has been amplified in accordance with the practice on the Pennsylvania System, New York Central Lines, Standard Steel Works Company and the Carnegie Steel Company.

In the proposed revision the paragraph covering chemical composition has been changed to show an increase in carbon and manganese, the omission of a specification for silicon and the chromium content for chrome-nickel steel decreased. The method of determining the elastic limit has been clarified and new material added relative to proof test.

Specifications for Welded Pipe to be superseded by two new specifications; one covering Welded Wrought Iron Pipe and the other Welded and Seamless Steel Pipe. This revision is for the purpose of covering wrought iron and steel pipe in separate specifications and making these specifications agree with present standard practice. The proposed specifications are more complete than the old specifications on welded pipe.

Specifications for Boiler and Firebox Steel for Locomotive Equipment to be revised so as to agree with recent standard practice and specifications of other societies. The proposed revisions change the carbon content for firebox steel, provide for a modification of elongation for material over ¾-in. in thickness by increases in 1/32-in. steps instead of by ⅛-in. steps and amplify the paragraph on marking.

Specifications for Rivet Steel and Rivets for Locomotive Tenders, Passenger and Freight Equipment Cars to be revised in agreement with standard practice as regards permissible variations in size in hot finished rivet bars.

Specifications for Carbon Steel Axles for Cars and Locomotive Tenders to be revised in order to provide additional tolerances where experience has shown such provision was necessary, and to cover certain changes in form in order to clarify the meaning. These revisions have been made in co-operation with the American Association of Steel Manufacturers' Committee on Axle Specifications. Allowable variations in turned diameters of smooth forged and rough turned axles have been increased. A change is also made in the section covering weights.

Specifications for Blooms, Billets and Slabs for Carbon Steel Forgings has the title changed to Carbon Steel Blooms, Billets and Slabs and Forgings. Chemical specifications for carbon and manganese have been revised for the purpose of bringing the different classes of steel in agreement with what is now standard. Clauses on analyses and chipping have been revised and amplified to clarify the meaning.

Specifications for Annealed and Unannealed Carbon Steel Axles, Shafts and other Forgings to be revised in order to bring the specifications in line with recent practice. The changes have been made in co-operation with the American Association of Steel Manufacturers' Committee on Axle Specifications. Modifications have been made in chemical specifications for carbon and manganese. The maximum speed of testing machine when making tension tests has been increased and provision made for three instead of only one retest. A rewording has also been made of the paragraph on workmanship.

Specifications for Malleable Iron Castings to be revised in order to bring them into agreement with current standards. Revision increases the minimum allowances for tensile strength and for elongation. Provision is also made for retests when bars fail on account of flaws.

Specifications for White Lead for Lettering to be revised in order to bring the specifications into agreement with current practice. Under chemical composition where it is now specified that the mechanical moisture combined with pigment and oil shall be not over 0.25 per cent by weight, it is changed to read, not over 0.70 per cent by weight.

Specifications for Boiled Linseed Oil to be revised in section 7. Loss on Heating by changing temperature figures of 115 to 125 deg. C. to read 105 to 110 deg. C.

Specifications for Raw Linseed Oil to be revised the same way.

Specifications for Turpentine to be revised in the paragraphs covering appearance, color and odor, also revision in paragraph 6 on other properties.

New recommended practice specifications

New specifications were submitted for Water Gage and Lubricator Glasses. These specifications cover three types of water gage glasses, namely, reflex, tubular and "bull's-eye," also "bull's-eye" type lubricator gage glasses. Specifications for physical properties and tests include optical test, dipping test, solubility test, pressure test and method of taking samples. Additional points cover permissible variations, workmanship and finish, wrapping and labeling, and inspection and rejection.

New specifications were submitted for Paint Reducing Oil used for mixing paste and semi-paste to the proper consistency of painting. The reducing oil to consist of not less than 35 per cent of fixed oil and drier with the remainder mineral spirits. The fixed oil to contain at least 50 per cent linseed oil, the remainder being drying or semi-drying oils. Specifications cover also special requirements, drying tests, elasticity test, number of tests and inspection and rejection.

The report is signed by F. M. Waring (chairman), engineer tests, Pennsylvania System; J. R. Onderdonk, engineer tests, Baltimore & Ohio; Frank Zeleny, engineer of tests, Chicago, Burlington & Quincy; A. H. Fetters, mechanical engineer, Union Pacific; H. G. Burnham, engineer of tests, Northern Pacific; J. C. Ramage, engineer of tests, Southern; J. H. Gibboney, chemist, Norfolk & Western; F. T. Quinlan, engineer of tests, New York, New Haven & Hartford; T. D. Sedwick, engineer of tests, Chicago, Rock Island & Pacific; G. N. Prentiss, engineer of tests, Chicago, Milwaukee & St. Paul; H. W. Faus, engineer of materials and equipment tests, New York Central; H. D. Browne, engineer of tests, Chicago & North Western.

Discussion

E. E. Chapman (A. T. & S. F.) said that the change in chemical specifications for firebox steel, which calls for the elimination of the lower limit in carbon is a step in the right direction but believed that consideration should be given to the lowering of the maximum limit for the carbon content for plates ¾ in. or under in thickness to not over 0.18 per cent and for plates over ¾ in. in thickness to not over 0.25 per cent carbon.

The committee recommended that the manganese in the thin plates have the upper limit reduced to 0.50 per cent in place of the present 0.60 per cent. Mr. Chapman objected to this recommendation because the manganese in moderate quantities is a cleanser of sulphur and phosphorus and produces greater resistance to the formation of cracks.

On motion, the report was accepted and referred to letter ballot of the division.

Report on safety appliances

Mr. Chambers: The committee has no written report this year. The principal work we have been engaged in is the arrangement for testing out the air brakes to comply with the Commission's requests in power brake appliance hearings. H. A. Johnson, our director of research, has a statement to make.

H. A. Johnson: The Director of Research was appointed in the early part of December, 1924, and instructed by the Committee on Safety Appliances of the Mechanical Division to proceed upon the following plan:

1—Steps will be taken to obtain appliances, which, it is claimed, meet the views of the Interstate Commerce Commission, as indicated in its preliminary report and conclusions. If the plans or specifications for such appliances are available and the appliances are not yet being manufactured, steps will be taken by the Director of Research to secure such appliances, even to the extent of entering into an agreement to have such appliances made.

2—As soon as such appliances have been obtained they will be given exhaustive tests on the test rack at Purdue University, which rack will be completely prepared and brought up to date for the purpose of this investigation.

3—Following the completion of the rack tests such devices will be given road tests, to develop whether or not they meet road conditions safely in service.

4—This program will be carried out with all dispatch and as promptly as the devices for these tests are available.

5—The investigation will also embrace such further study as may in the judgment of the Director of Research throw further light upon this problem.

In response to inquiries sent to the Westinghouse Air Brake Company, the Automatic Straight Air Brake Company, and the New York Air Brake Company, the American Railway Association has purchased from each of the first two named companies 150 sets of freight air brake equipments, which, it is claimed, meet the views of the Interstate Commerce Commission as indicated in its preliminary report and conclusions. Both companies are now manufacturing these equipments.

A contract between the American Railway Association and the Purdue University Engineering Experiment Station has been entered into covering the use of the facilities of the University during the rack tests, which will be made upon the American Railway Association test rack. The test rack has been redesigned and is now being rebuilt to represent two Type ET locomotive equipments and 100 modern freight car equipments. The test rack is being arranged to accommodate the several types of equipment which will be submitted for test and this necessitates lengthening the rack 25 per cent. An order has been placed with the Westinghouse Air Brake Company covering the two Type ET locomotive equipments and the necessary material for placing the rack in first-class condition. Practically all of this material is now at the University or has been shipped. The length of brake pipe per car is being increased from 42 ft., center to center of hose couplings, to 50 ft., center to center of hose couplings, which more nearly represents average present day conditions.

In the conduct of these tests automatic recording instruments will be used, wherever possible, to eliminate the human element in reading and recording results. As there were no instruments on the market suitable for this work, it has been necessary to design and develop new instruments. These instruments are now being manufactured.

The drafting of a schedule of tests, to which the various equipments will be subjected, is well under way. This schedule will include the American Railway Association code of tests and such additional tests as are necessary to develop the additional functions provided for in the preliminary report and conclusions of the Interstate Commerce Commisison. Upon completion the schedule of tests will be submitted to the Bureau of Safety of the Interstate Commerce Commission, the manufacturers submitting equipment and the Committee on Brakes and Brake Equipment of the American Railway Association, for their criticism and suggestions. It is to be understood that the schedule of tests may be modified or revised as the tests progress, if such modification appears desirable in the opinion of the Director of Research. The present standard Type K freight equipment will be tested first in order to establish a proper basis for comparative results. The Type K triple valves, which have been installed on the test rack for a number of years, will be replaced by the Westinghouse Company with new Type K triple valves.

It is expected that the rack tests will be started during the early part of September and be completed by the end of the year. The men who will act as official observers during the tests will be selected largely from the staff of professors and instructors of Purdue University who are skilled in carrying on scientific researches and who will be unbiased in their judgment. All work performed by the University staff will be under the direction of the Director of Research, who will be responsible for the conduct of the tests and the results obtained just the same as if the observers were on his own payroll. The Bureau of Safety of the Interstate Commerce Commission, the manufacturers submitting the equipment, and the American Railway Association will be invited to have representatives present during the tests.

No definite plans have yet been made in connection with carrying on road tests, as the nature of the road tests will depend somewhat upon the results obtained on the test rack. Road tests will probably not be undertaken before next spring or summer as the rack tests will not be completed before winter sets in.

The Director of Research is making semi-monthly reports of the progress of the investigation to W. P. Borland, Director, Bureau of Safety, Interstate Commerce Commission with copies to R. H. Aishton, President, American Railway Association, C. E. Chambers, Chairman, Committee on Safety Appliances and V. R. Hawthorne, Secretary, Mechanical Division. In this manner the Bureau of Safety and the officers of your Association are kept thoroughly informed of every move made and are given the opportunity of making suggestions as the work progresses.

As many of you as possible should visit the University sometitme during the conduct of the tests, or have your air brake man drop in for a few days to see how the work is going on. I would be very glad to have you come and have your suggestions.

Report of committee on wheels

The new cast iron wheel specifications adopted in 1923 are now in general use and appear to be meeting with approval both from the users and the manufacturers. It has been found in practice that the extra requirements in these specifications, as compared with the old, have not caused the manufacturing difficulties which were anticipated by some makers. There is no question but what these specifications are proving a help in getting better wheels.

During the year your committee has discussed the question of still further increasing the requirements of the specifications, particularly as regards thermal test, in an effort to get further protection against cracked plate wheels. A considerable number of experiments must be made before any such recommendation could be presented by the committee, and it is planned to go into this question during the coming year as well as to hold conferences with the manufacturers in regard to same. Consideration will also be given to the inclusion in the specifications of a prescribed method of chemical analysis.

Developments in cast iron wheel design

During the year your committee has been watching the developments in the design of cast iron wheels. They witnessed the making of wheels with a lip chill at one foundry and examined some which had been in service for a number of years, in order to get an idea as to the relative merits of these lip chill wheels and the sand rim type. Wheels of both types were broken under the drop and examined to determine the nature of the metal at the rim. The committee came to the conclusion that the lip chill wheel is less liable to chipping of rim, and that a saving may be accomplished by its use since there are a very large number of wheels removed from service because of chipped rims.

The most interesting development in cast iron wheels is the single plate design. Tests which are being made of the 850-lb. single plate wheels in engine tender service have not progressed sufficiently to warrant the committee making any report on them. Up to the present time we know of no single plate wheels of lesser weight which have been put to service, but we anticipate that some such wheels will be produced and are hopeful that they will prove a help in the reduction of cracked plate wheels, particularly in high speed freight service, such as in refrigerator cars. There has undoubtedly been a radical improvement in the cracked plate wheel situation since the adoption of the heavier arch plate designs. However, cracked plates are still a problem and your committee hopes to co-operate with the manufacturers in an effort to still further improve the designs of the wheels.

Grinding of cast iron and steel wheels

Your committee made a series of tests on a wheel grinding machine in the shops of one of the member railroads. The grinding machine is built by the Norton Company, Worcester, Mass. The machine is motor connected by chain drive to a shaft which in turn is connected to the grinding wheels and drive for wheels in lathe by flexible leather belts. The grinding wheels cost $27.52 each and average about 200 slid flat cast iron wheels before they are replaced by new grinding wheels. The machine is operated by one man employed at a rate of 62 cents an hour.

Grinding cast iron wheels removed from service on account of slid flat spots, the lathe will average two pairs of wheels per hour or 16 pairs per eight hour turn. Grinding steel wheels removed on account of slid flat spots, the average output would be

somewhat greater as the time required per pair of steel wheels is less than per pair of cast iron wheels. Grinding new cast iron wheels to insure rotundity, the output is four pairs per hour or 32 pairs of wheels per day average.

The second pair of new wheels applied in the lathe were cast by the Griffin Wheel Company for refrigerator car service, 700 lb. wheels, September 15 and September 26, 1924, tape 3, A. R. A. 1917. Application of a gage prior to the grinding operation indicated lack of rotundity of about 1/32 in. During the grinding, this out of round condition became apparent as soon as the grinding wheel was applied to the wheel tread and wheels were revolved in the lathe. It should be noted that unless a gage is used, a considerable number of new cast iron wheels would be swung into the grinding machine needlessly. Considerable labor and time can be saved by the use of a rotundity gage applied to the journal with contact point in the center of the wheel tread, the wheels to be rolled on the track and the contact of the gage point with the tread noted.

Grinding slid flat rolled steel wheels

A pair of slid flat rolled steel wheels with good flanges were selected for test and one wheel of the pair was ground to correct the slid flat spots, the mate wheel later being turned in a wheel turning lathe. On the first wheel, one slid flat spot was 3 in. in length and two additional spots totaled 4 in. in length. The grinding operation resulted in a loss in wheel diameter of 1/16 in., a reduction in tape size from 262 to 260½ or a loss in service metal of 1/32 in. The mate wheel, with a slid flat spot 3¼ in. in length, was placed in a turning lathe for turning in accordance with ordinary practice. The saving in service metal for the pair of wheels if ground instead of turned would amount to 3/16 in. service metal per wheel at $2.03 or 6/16 in. for the pair of wheels, which represents a total saving in value of service metal of $12.18. It should be noted further that the labor for the grinding operation was less than one-quarter hour at 63 cents per hour for grinding as compared to a labor item of three-quarters hour at 75 cents per hour for the turning operation is a considerable saving over the old method.

One of the principal objections which has been raised against the practice of grinding slid flat wheels has been based on the fear that a ground wheel would develop a comby spot at the same location as the original flat spot due to thermal cracks. The best answer to this contention is the experience of those roads which have been following this practice for many years. This shows that these comby spots do not develop. In fact the records show that some wheels have been ground three times. It is important however that the wheels to be ground be carefully selected and only those in good condition except for the flat spot be ground. No shelled, comby or badly tread worn or flange worn wheels should be considered for the replacing of these wheels after grinding would not be considered good practice.

It is estimated that a grinding machine, completely installed, will cost $10,000. It is interesting to note that it has been the experience of one road that a large percentage of the cast iron wheels removed on account of slid flat spots were new wheels. This is probably due to the tendency of out of round wheels to be bound in the trucks by the brake shoe application resulting in slid flat spots in cast iron wheels. It follows naturally that when new wheels are placed in the machine and ground after mounting, the number of wheels removed on account of slid flat spots would be reduced to a considerable extent and that further the loss incident to scrapping of new cast iron wheels removed from service on account of slid flat spots is greater than appears to be the case when considering the difference in value between new cast iron wheels and second hand cast iron wheels than scrap cast iron wheels under A. R. A. Rules of Interchange. For instance, the A. R. A. price quoted for 750-lb. cast iron wheels new is $17.40; second hand value $9.55; and scrap $6.30. To reclaim the wheels as second hand rather than scrap results in a saving of $3.25 per wheel or $6.50 per pair, but this does not represent the actual saving for wheels reclaimed after removal from service on account of slid flat spots on comparatively new wheels. Furthermore, these wheels are better than the average second hand wheel since wheels with badly worn flanges, brake burns, etc., are not ground. To the actual saving of $6.50 in value of the wheels should be added the saving represented by cost of dismounting, remounting, boring, etc., and other operations necessary for the completion of the work.

Cost of grinding slid flat cast iron wheels

Labor ½ hour at 62 cents	31 cents per pair
Interest and depreciation at 10 per cent, $10,000 first cost (1924 price), 3,000 pairs ground per year	33 cents per pair
Power 12 k.w.h. at 1½ cents	18 cents per pair
Grinding wheels at $55 per pair	37 cents per pair
150 pairs wheels ground per pair grinding wheels	
	$1.19 per pair
Saving per pair based on second-hand values	$5.31
Saving per pair based on new values	$21.01

Gage for re-mounting wheels

There has been considerable controversy in regard to the use of the cast iron wheel re-mounting gage shown on pages 45 and 46 of Section B of the Manual. It appears that these gages have been used improperly by some railroads and such use has resulted in the wastage of serviceable material. This gage provides for a satisfactory and definite way of classifying second hand cast iron wheels as between scrap and second hand for billing purposes. It was never intended for steel wheels, though some of the roads have been using it in their shops for this purpose. In order to clarify this matter, the committee recommends that the title for this gage be changed to read: "Limit Gages for A. R. A. Billing Classification of Second Hand Cast Iron Wheels." (The committee felt that there was no need for both of the remounting gages shown on page 45 (Section B) of the Manual and recommended that the second figure on this page be eliminated and the title under the first changed so that it will refer to all cast iron wheels. Since the maximum wear limit on flanges is 1 7/16 in., it was also felt that 1 5/16 in. is a fairer limit than 1 3/16 in. The committee report also included an explanation of Interchange Rule 24, and some important recommendations regarding the mounting of wheels, the use of pressure gages for wheel presses and mating of steel wheels.—Editor.)

Questionnaire on steel wheel wear and contour

In accordance with the committee's 1924 report, a questionnaire was sent to all railroads to gather information as to their practice regarding tread wear of steel wheels and also as to the desirability of using a standard contour for driving tires and all other wheels, particularly to determine if a 1 in. flange height for driving tires would be satisfactory. This questionnaire developed the fact that there was a great difference of opinion on these questions. The vote was approximately evenly divided for and against the 1 in. flange on drivers, though the majority stated that it would be advantageous from a shop viewpoint. Your committee is of the opinion that the 1 in. flange, which incidentally is being used by a number of roads and is used on engine truck wheels, should be standardized. However, in view of the large number of roads opposing such practice, your committee will not make such recommendation at the present time, but will continue its observation of results secured by those roads who are using this type of flange on driving tires.

Steel wheel specifications

During the past year your committee has given a large portion of its time to the consideration of wrought steel wheel manufacturing processes. A sub-committee has visited the plants of most of the manufacturers and studied the various processes used. We have also held a conference with the representatives of the different manufacturers and upon our request they have formed a technical committee to work with your committee in the development of the wrought steel wheel. A suggestion was made that the specifications be changed to include a number of new requirements regarding process of manufacture. After a conference with the manufacturers, your committee decided that a better procedure would be to work out the various problems involved through the technical committee and leave the specifications as they are, at least, for another year, pending the results of these further studies. The service to which steel wheels are being put is becoming more and more exacting, particularly in locomotive tenders, and improved processes are necessary to fully meet these requirements. We are glad to report that the manufacturers, by the formation of this Technical Committee, are showing a spirit of co-operation in working toward a solution of these difficulties and we are very hopeful that the next year will produce changes and improvements which will prove most helpful to the users of wrought steel wheels.

Your committee has found that there are very few 38 in. wrought steel wheels now in service and they therefore recommend that such wheels be removed from the standards of the Association.

Limits of wear on rolled steel wheels

At the last meeting the committee recommendation to reduce the limit of wear for rolled steel wheels in switch engine tender service was approved. The matter was referred to Mr. Pack of the Interstate Commerce Commission and he has issued a ruling permitting this lower wear limit under the I. C. C. Inspection Rules. The railroads are therefore able to take advantage of this further saving of wheels.

The committee was requested to consider reducing the limit of wear on all tender wheels and also on all passenger wheels. Though all the reports indicate that no trouble is being experienced with the lower wear limit in freight cars, your committee does not feel that sufficient experience has been had with these lower limits to warrant their making such recommendation at this time. We wish to protect passenger car and engine service in every possible way and it should be remembered that passenger car wheels worn to 1 in. need not be thrown away as they can then be transferred to freight service. All of the roads are not taking advantage of this possible extra service of wheels, and the committee urges that they give it consideration.

The rolled steel wheel is not permitted to be worn under passenger cars or under tenders of road engines to less than 1 in. rim thickness. It is probable that this amount of dead or unused metal is more than safety requires. This limit was established in the days when steel wheels were mostly steel-tired with an independent center. This type of wheel did not have the strength in the rim which is possessed by the single plate rolled steel wheel of today. It seems reasonable that the rim of the more modern rolled steel wheel can be worn to a thinner section than can the rim of the steel tired or assembled wheel. If this is correct, the present standard of 1 in. thickness at which rolled steel wheels are condemned from passenger service and road engine tenders, wastes some metal in each wheel.

In order that the railways may be supplied with the best information available as to what is safe and advisable in this matter, it is recommended that a questionnaire be sent each railway for its filling out with the results of its experience and its views. This questionnaire is to be worded so clearly that it cannot be misunderstood, and to develop data which can be compiled on a common basis for conclusions.

Manual of wheel shop practice

In accordance with statement made in our 1924 report, we have prepared a manual of wheel shop practice. The committee has devoted a large amount of time to the preparation of this book and we are presenting it for your consideration at this time with the understanding that it is not a fully finished piece of work. The section covering classification and causes of defects is particularly needful of further study and development. The committee believes that thru co-operation with the technical committee of the wrought steel wheel manufacturers during the coming year more conclusive information will be developed. Undoubtedly, there will be found many features which can be improved upon and the committee presents it with the request that during the coming year the members furnish criticisms and suggestions for changes and it is hoped by the end of another year the committee can revise the Manual so as to put it in finished shape for issuance to those interested.

(The committee here inserted a copy of the proposed manual of wheel shop practice, which is profusely illustrated and contains 20 main subdivisions of this important work. It forms a 100-page booklet.—Editor.)

The report was signed by C. T. Ripley, chairman, chief mechanical engineer, A. T. & S. F.; O. C. Cromwell, assistant to chief of motive power and equipment, B. & O.; H. E. Brownell, general foreman foundry, C. M. & St. P.; G. B. Koch, general foreman foundry, Penna.; H. W. Coddington, engineer tests, N. & W.; A. Knapp, inspection engineer, N. Y. C.

Discussion

The discussion of this report was opened by Mr. Ripley, who stated that the committee wished to withdraw the recommendation that the title of the remounting wheel gage be changed, as this might cause controversy.

A. H. Fetters (U. P.) read a prepared discussion by O. S. Jackson (U. P.), in which he commended the disposition made of the question of the proper limit for wear for rolled steel wheels under switch engine tenders, stating that with the new method many dollars will be saved. He went on further to state that one of the most perplexing and annoying problems coming to the attention of the railroads has been the large proportion of rolled steel wheels removed from heavy road tenders on account of being shelled out. While admitting the heavy loads imposed, it seems that the material is not what it should be and offers an opportunity for investigation by the wheel committee during the coming year.

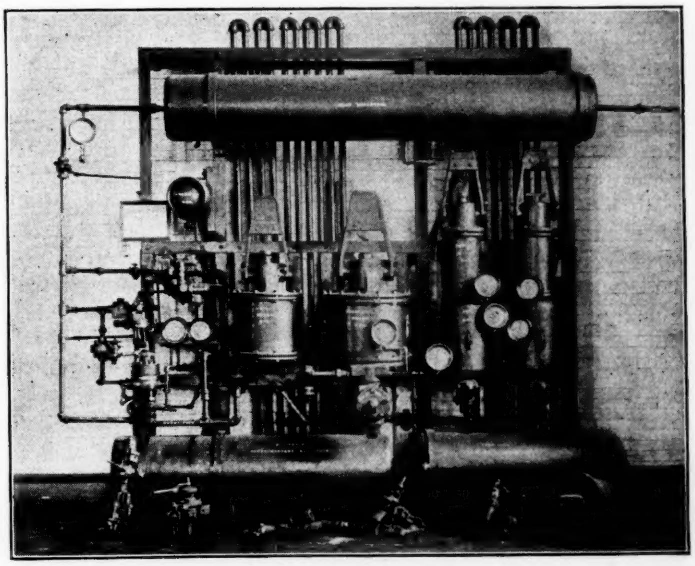
A. E. Calkins (N. Y. C.) presented a prepared discussion. He stated that with a few minor exceptions, the 1923 cast iron wheel specifications were incorporated in the New York Central specifications as of January 1, 1925, and present indications show that excellent results may be anticipated from these wheels. He said that the remounted gages shown in the manual have never been used on his road for remounting determinations, as the flange thickness requirement of these gages is too severe and if recognized would result in an alarming economic loss.

The N. Y. C., he said, intends to try out the wheel axle centering gage as it is superior to the existing method of measuring. He took exception to the suggestion that a more general use of hydrauligraphs be obtained through a provision in the interchange rules, stating that it is N. Y. C. practice to insist on the general use of the autographic type and to require press operators to show the axle size as well as the wheel number in order to carry out the checking of wheel mounting data in the general offices in addition to the surprise checks made during the day.

Mr. Calkins expressed the hope that during the coming year the wheel committee would investigate and incorporate in the manual some further data and perhaps drawings of fillet gages for various journals which will tend to increase the life of axles. He also suggested that the committee include in the manual a provision to the effect that wheel shops should stencil on each end of the axle inside of the wheel seat, the actual diameter of each wheel seat. This, he said, proves of great value to billing clerks at shops where wheels are applied.

Interesting comments were made by G. S. Goodwin (C. R. I. & P.) pertaining to the grinding of slid flat wheels. He stated that for the past month, his road had tried out with success a new portable wheel grinder reclaiming slid flat wheels by grinding off the high spots on a 14-in. arc on the wheel circumference. On 12 pairs of wheels ground, he said, a total of 251 min. was required, which gave an average of 21 min. per wheel at a cost of 40 cents which did not include electrical current or shop prorata; the flats varying between 2½ in. and 3 in. and the metal removed ranging from 3/64 in. to 1/16 in. All of the wheels thus ground, he said, had been restored to service on the road's own equipment and up to the present time, no reasons have been discovered why this treatment should not be continued.

The report was accepted and referred to letter ballot.



Air brake demonstration equipment used for instruction purposes at Yale University

Character of wheel and rail contact

Above critical speed flat spots or track depressions cause contact failure — Spring supported brakes amplify this condition

By John P. Kelly

Senior engineer, Bureau of Signals and Train Control Devices, Interstate Commerce Commission

THE sliding of wheels while brakes are applied for the purpose of controlling the motion of a train is a decidedly objectionable occurrence which should be provided against mechanically as effectually as possible. Everyone fairly well informed concerning the braking art knows that it is on the practically continuously maintained frictional resistance between the wheel and the rail, during the time the brake shoes are pressed against the wheel peripheries that the brake is dependent for its efficacy in retarding the motion of the train.

If the magnitude of the frictional force excited between the wheel and the rail during the time brakes are applied, acting to keep the wheel rotating, is constantly maintained equal to the brake shoe frictional force, acting at the periphery of the wheel to stop its rotation, the vehicle will come to a stop without wheel sliding.

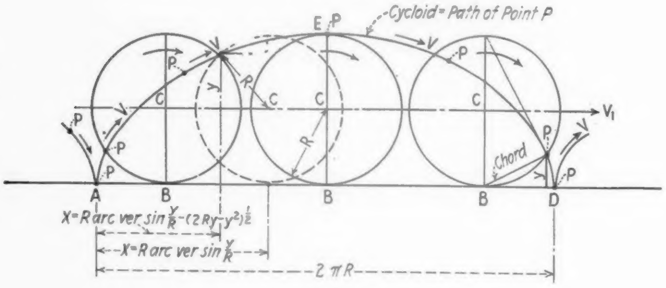


Fig. 1

Experiment has amply demonstrated that the coefficient of friction which exists between the wheel and the rail, while the former is motionless, is about 0.32 of the weight resting on the rail under the wheel at the point of contact; hence the maximum resisting force which the brake can oppose to starting the car from a state of rest must equal the weight carried to the rail multiplied by this coefficient. While a car is in motion, assuming that the wheel and rail contact is constant and also that the weight carried to the rail is constant and equal in magnitude to that impressed upon it when the car is motionless, could we develop a braking frictional force at the periphery of the wheel equal to 0.32 of the weight of the car we should then be able to stop it on a level track from a speed of 60 miles per hour in a distance of about 376 ft. and in 8.5 seconds from the point and from the instant of application of the brake.

In the theory of train braking the first and most important consideration is, then, that of the character of the wheel and rail contact, whether constant or intermittent, while the car is in motion; and if intermittent, to what degree it is so and why. In what follows the ideal and the actually existing conditions touching upon this matter will be considered.

Theoretically, a perfectly circular wheel, rolling without slipping on the surface of a perfectly level track at any speed, will always have its rail contact point stationary with respect to the rail.

Let the circle shown in Fig. 1 start to roll in the direction indicated by the arrow, the point *P* being in contact with the straight line *A D* at the commencement of the rolling motion. At the completion of one rotation the center *C* will have moved parallel to the line *A D* a distance equal to $2 \pi R$ the circumference of the circle, *R* being the radius and $\pi = 3.1416$, being the ratio of its circumference to its diameter.

The point *P*, during this rotation, will have turned through one complete revolution about the center *C*; it will also have advanced horizontally the same distance as the center *C*, and be again in contact with the line *A D* at *D*. The path in space traced out by point *P* during this rotation is indicated in the curve *A E D*, which curve is the well known cycloid.

It is evident from an inspection of the figure that when *P* comes to the line *A D* it is motionless with respect thereto, for, the rotation continuing, the direction of the motion of *P* changes to the opposite of what it was in coming to the line. This fact, as well as that of the variable cycloidal velocity of *P* at different points in the curved path may be proved mathematically. Referring to Fig. 1.

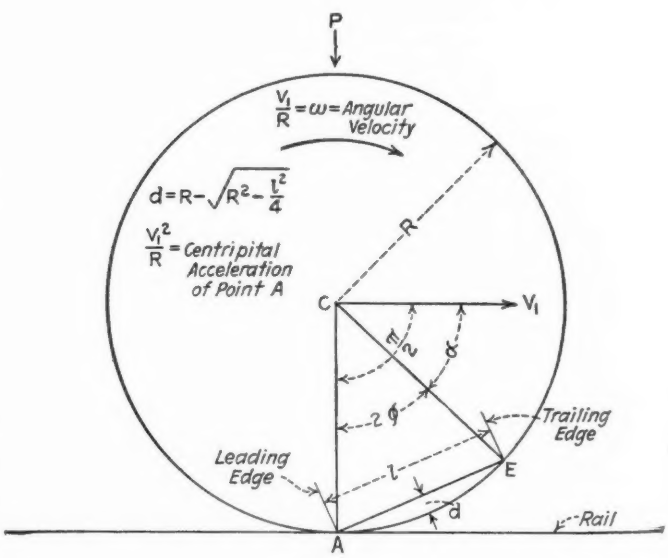


Fig. 2

Let V = the velocity of point P at any position in its cycloidal path,
V_1 = the velocity of the center parallel to the line AD,
R = the radius of the circle,
x = the abscissa which coincides with the point of contact on line AD, on which the circle rolls, and
y = the ordinate to any point of the cycloid. The center C moves at the same rate as the successive points of contact B, and it is always vertically over B.

From the equations of the cycloid shown in Fig. 1 and the theory of curves it may be demonstrated that

$$V = \sqrt{\frac{2y}{R}} \times V_1$$

Hence if $y = O$ then $V = O$, the contact point is motionless with respect to the line AD

$y = R$ then $V = \sqrt{2}\,V_1$

$y = 2R$ then $V = 2V_1$

$y = \frac{R}{2}$ then $V = V_1$

The velocity of any point in the circle, corresponding to or coinciding with any point in the cycloidal curve, is the same with respect to the straight line on which the circle rolls as that which it would have if the whole circle revolved about the point of contact at the same angular velocity as that of the generating circle itself. For the length of the chord which corresponds to the ordinate y, Fig. 1, (at the right) as may be easily discerned from its geometry, equals $\sqrt{2\,Ry}$, and hence if

$$V : 2V_1 :: \sqrt{2\,Ry} : 2R$$

We again have $V = \sqrt{\frac{2y}{R}} \times V_1$

From the foregoing it is clear that, at the instant any point of the circle is in contact with the line, it has no velocity with respect thereto, and the velocity of the highest point, diametrically opposite the contact point, is twice that of the center.

Cause of intermittent wheel and rail contact

Were this ideal condition to obtain practically for the car wheel rolling along the rail surface, then no justifiable exception could be taken to the statement so generally made, that the coefficient of friction between the rail and the wheel has the same constant value while the wheel is rolling as it has while the wheel is motionless. Unfortunately, however, this ideal condition never obtains in practice for the rolling car wheel, and because it does not, the wheel and rail contact pressure, while a car is in motion, is of a variable and intermittent character.

We shall now consider the conditions which affect rail contacting of the rolling car wheel, using the case of the rotating flat wheel for illustration. This will enable us, although it is not of prime importance here, to determine at the same time the striking velocity of the flat's trailing edge.

Car wheels, as customarily assembled in trucks, always carry a spring supported load, a fact that should be kept in mind during the discussion which follows:

Referring to Fig. 2, let

R = radius of the wheel in feet,
l = length of flat spot in feet.
d = depth of flat spot in feet,
V_c = criticial speed of the wheel in feet per second,
V_1 = velocity of the center of the wheel, parallel to rail, in feet per second,
V_s = striking velocity in feet per second of the trailing edge of the flat spot,
ω = angular velocity of the wheel,
P = pressure of the truck equalizing spring, in pounds, on the wheel (considered the same as when the wheel is stationary),
W = Weight of wheel in pounds (this weight to include weight of all parts of the truck not spring supported),
g = acceleration of gravity = 32.2 feet per second per second

Then,

$$d = R - \sqrt{R^2 - \frac{l^2}{4}}$$

$$a = \frac{\pi}{2} - 2\,\phi = \frac{\pi}{2} - 2 \text{ arc sin } \frac{1}{2R}$$

When the wheel is in the position shown in Fig. 2 it is instantaneously turning about the point A, the leading edge of the flat spot, and the resultant vertically upward acceleration of $A = \frac{V_1^2}{R}$ feet per second per second. The whole wheel has, at the same instant, due to the downward pressure of the truck equalizing spring, avertically downward acceleration equal to

$$\frac{P + W}{W} \times g = g_1 \text{ feet per second per second.}$$

The upward acceleration $\frac{V_1^2}{R}$ and the downward acceleration g_1 are directly opposed to each other; hence the critical speed for point A will occur when the magnitude of the opposed accelerations are equal, that is, when

$$V_1 = V_c = \sqrt{g_1\,R} \text{ feet per second.}$$

Before the critical speed is attained the striking velocity of point E, the trailing edge, will be given very nearly by the expression

$$V_s = \frac{1}{R}\,V_1$$

from which it is clear that for any given wheel and flat spot the velocity with which the trailing edge will strike the rail will increase proportionately with the speed from

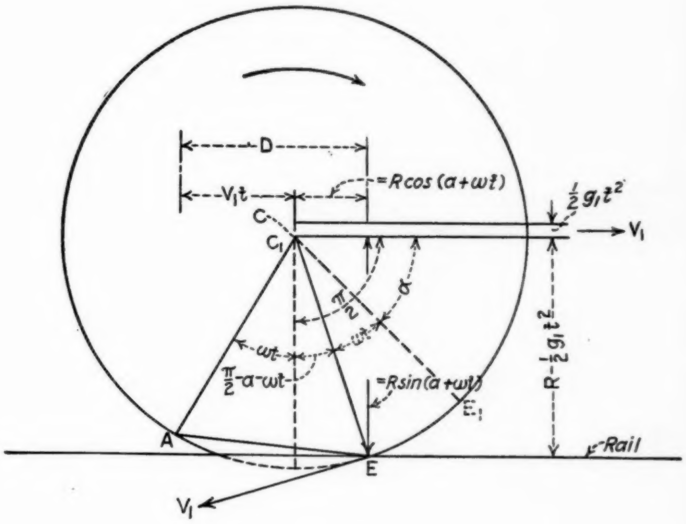


Fig. 3

zero up to the critical speed, that is, up to when

$$V_s = \frac{1}{R} \times \sqrt{g_1\,R} = 1\sqrt{\frac{g_1}{R}}$$

after which, as the equation shows, it remains practically constant regardless of increase of velocity. This means, of course, that after the critical speed has been slightly exceeded the leading edge of the flat spot rises off the rail before the trailing edge strikes it, that is, the wheel breaks its rail contact at the flat spot completely.

In view of the important part which the truck equalizing springs play in the prevention of wheel sliding during brake applications made to control the motion of the car, the following explanation of the fact that the leading edge of the flat does actually rise off the rail before the trailing edge strikes it, is submitted:

When the velocity of the wheel's rotation has reached the value where

$$V_1 = V_c = \sqrt{g_1\,R}$$

let t seconds equal the elapsed time betwen the rising off the rail of point A and the striking of point E. During this interval the path of E will be the resultant of three distinct motions (see Fig. 3), namely:

1—Translation; that of the wheel as a whole which moves $V_1 t$ feet horizontally forward:

2—Vertically downward as a whole $\frac{1}{2}g_1t^2$ feet; and one of

3—Rotation, or angular motion ω, that of the wheel about its own center through the angle ωt during which E moves from E_1 down to the rail at E. Hence

$$\frac{1}{2} g_1 t^2 + R \sin (a + \omega t) = R \qquad (1)$$

The distance between the point of departure of A and the point of striking of E is

$$D = V_1 t + R \cos (a + \omega t) \text{ feet.}$$

At the instant of striking, the vertical downward velocity of the whole wheel is g_1t feet per second. The velocity of E, due to rotation about the center C is V_1, perpendicular to CE. Its vertical component is

$$V_1 \cos (a + \omega t)$$

Therefore, the vertical striking velocity of point E, the instant it comes to the rail, is

$$V_s = g_1 t + V_1 \cos (a + \omega t) = g_1 t + R\omega \cos (a + \omega t) = g_1 t + R\omega \sin \left(\frac{\pi}{2} - a - \omega t\right)$$

But since $\left(\frac{\pi}{2} - a - \omega t\right)$ is a very small angle we may say

$$V_s = g_1 t + R\omega \left(\frac{\pi}{2} - a - \omega t\right) = t\,(g_1 - R\omega^2) + R\omega\left(\frac{\pi}{2} - a\right) \qquad (2)$$

From equation (I)

$$\frac{1}{2} g_1 t^2 + R \cos \left(\frac{\pi}{2} - a - \omega t\right) = R$$

and as before $\left(\frac{\pi}{2} - a - \omega t\right)$ being small we may place

$$\frac{1}{2} g_1 t^2 + R \left[1 - \frac{\left(\frac{\pi}{2} - a - \omega t\right)^2}{2}\right] = R$$

so that solving for t we get

$$t = \frac{\frac{\pi}{2} - a}{\omega + \sqrt{\frac{g_1}{R}}}$$

Substituting this value of t in (2) we obtain

$$V_s = \left(\frac{\pi}{2} - a\right)\left[\frac{g_1 - R\omega^2}{\omega + \sqrt{\frac{g_1}{R}}} + R\omega\right]$$

$$= \left(\frac{\pi}{2} - a\right)\left[\frac{g_1 + R\omega\sqrt{\frac{g_1}{R}}}{\omega + \sqrt{\frac{g_1}{R}}}\right]$$

$$= 2 \text{ arc sin } \frac{l}{2R} \times \sqrt{g_1 R}$$

For small flats, three inches or less in length.

$$\text{arc sin } \frac{l}{2R} = \frac{l}{2R}; \text{ therefore}$$

$$V_s = 2\,\frac{l}{2R} \times \sqrt{g_1 R} = l\sqrt{\frac{g_1}{R}},$$

as before stated, showing conclusively that after the critical speed is exceeded the entire weight carried to the rail by the wheel is removed therefrom at each revolution, as the flat passes directly under the wheel's center; and that the striking velocity of the trailing edge of the flat becomes practically constant and independent of the speed of rotation.

For a 36-in. wheel, having a 2-in. flat, which carries a spring supported load of 12,500 lb., and under the spring 1,250 lb., the critical speed at which the leading edge of the flat rises off the rail is about 22 ft. per second or about 15 miles per hour; and the constant striking velocity of the trailing edge of the flat spot is about 2.5 ft. per second.

Practically, all car wheels may be said to have infinitesimally small flat spots in their peripheries; that is, their peripheries are never geometrically perfect circles however carefully they may be formed in the molds or turned in the lathe. Again, when the wheels are mounted on their axles the geometrical axes of the wheel and axle rarely coincide so as to be identical, although it is only in rare cases that the peripheries of wheels vary sufficiently from being perfect circles or the axes from coincidence to make the difference of great moment; but these points are mentioned merely to show that so far as the wheel is concerned it does not, even if it were rolling along a perfectly level rail surface, carry to the rail during every instant of time and at every point in its periphery, above certain critical speeds, a uniform pressure the equivalent of the load it is carrying, and this for the same reasons that, as just explained, the flat wheel does not do so.

A casual glance along the surface of the track of any railroad will disclose more or less undulating variations in it, the magnitude of which will depend largely on the character of maintenance, and on weather conditions generally; the character of the rail surface is a consideration of very great weight, as affecting the magnitude and constancy of the pressure between the rail and the rotating wheel.

But with the best practicable track maintenance and under the most favorable weather and temperature conditions it is impossible to maintain track surface uniformly smooth and even. In track laid with brand new rail, after a period of four or five years, if the traffic be heavy, the surface of the rails will be found higher at the rail centers than at the ends, where the track is laid with even joints; and where laid with broken or staggered joints, the surface will be lower at the centers and higher at the quarters. This condition of surface results from the action of the rotating wheels over it, cold rolling the surface metal and, consequently, rendering it more or less undulating in character.

Effect of brake shoe suspension on intermittency of contact

Taking the combination of the more or less flat condition of the wheel with the uneven rail surface it is quite evident that while the speed is above the critical point, the contact between the wheel and the rail is of a highly intermittent character, and that it remains such until the velocity reduces to a point below the critical when it becomes constant and remains so until the stop.

We shall now consider the effect which a brake application produces on the wheel and rail contact intermittency where the brake shoes are suspended from some spring supported portion of the truck. *Where the brake shoes are hung under the spring, a brake application does not affect the intermittency of contact.*

Fig. 4 represents one of the wheels of a six wheel passenger equipment truck, fitted with the single shoe type of brake rigging, with the brake released, and with the brake shoes hung far below the wheel center. The truck equalizing spring is shown normally distended and in condition to provide the deflection necessary for com-

fortable riding, so that the vertically downward acceleration of the wheel is, as before shown,

$$\frac{P + W}{W} \times g = g_1$$

In Fig. 5 the same wheel and truck brake rigging is shown, with the brake heavily applied, the magnitude and direction of the resolved brake shoe pressure indicated, the resultant vertical force between the truck equalizer and the top rail of the truck frame indicated by the vector *A*, sufficient to compress the equalizing spring solid and to hold it in the solid compressed state as long as the brake remains applied with the same force.

The force indicated by the vector *B*, though normally impressed on the truck pedestal jaw, causes a high frictional resistance to vertical movement of the journal box,

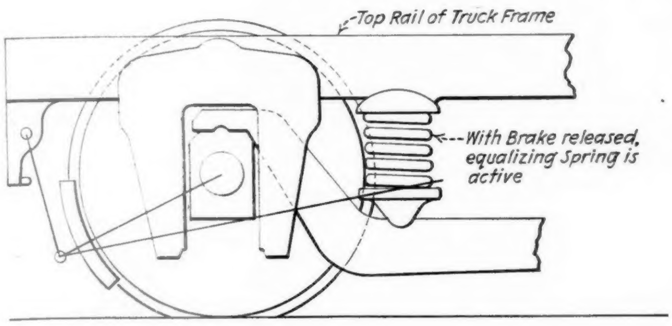


Fig. 4

and thus aids in holding the box rigid in the pedestal jaw.

Assuming that the ratio of the spring supported weight to the non-spring supported weight, or weight under the spring, is 10, the accelerating effect of the equalizing spring on the wheel, while the brake is released, as shown in Fig. 4, is 322 ft. per second per second; and when the brakes are applied, as indicated in Fig. 5, it is only 32.2 ft. per second per second.

This difference in the accelerating effect of the equalizing spring produces a condition which is highly conducive to wheel sliding; first by increasing the length of the non-contacting of the wheel and rail, and secondly by lowering the point of the critical speed.

Referring to Fig. 7, let the ratio of the spring supported

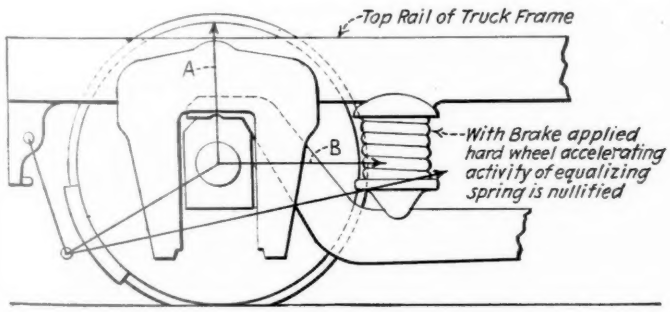


Fig. 5

weight to the non-spring supported weight be 10 as before, and the speed of the vehicle 88 ft. per second (60 miles per hour), then the wheel, if rolling into a rail depression 1/64 in. deep and of sufficient length, with brake released as indicated in Fig. 4, will lose its contact with the rail, removing entirely its pressure therefrom for a distance of 10.4 in.; if the equalizing spring be compressed solid so that the wheel and journal box is held rigid in the pedestal jaw, as indicated in Fig. 5, the contact will be lost for a distance of very nearly 33 in., so that over the distance indicated no rail frictional force is acting in opposition to the brake shoe frictional force tending to stop the wheel's rotation.

The only force during the non-contact period opposed to the brake shoe frictional force is the rotative energy within the wheel itself.

A pair of 36-in. wheels and an axle, such as is generally used in the six-wheel truck under a car weighing 150,000 lb. will weigh about 3,200 lb. The square of the ratio of the radius of gyration in such a pair of wheels and axle to the square of the radius of the wheel is about 0.55, and the rotating energy in foot-pounds of such a pair of wheels and axle at 88 ft. per second will be given by the formula.

$$E_R = \frac{W K^2 V^2}{2 g r^2}$$

in which

E_R = rotating energy in ft.-lb.
r = radius of wheel
V = linear velocity of a point r feet from the axis in ft. per second
W = weight of wheels and axle in lb.
K = radius of gyration, and
g = 32.2

Then substituting values for letters in the formula we have $\frac{3{,}200 \times 0.55 \times 88 \times 88}{2 \times 32.2} = 211{,}637$ ft.-lb. At 88 ft. per second, with a braking ratio of 165 per cent the coefficient of brake shoe friction is about 10 per cent. Hence, in the case of the wheel that carries a weight of 13,500 lb. to the rail we have a shoe pressure acting on

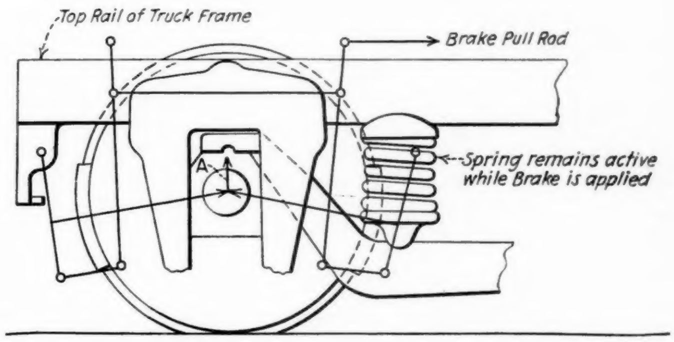


Fig. 6

the periphery of the wheel, taking the efficiency of the brake rigging at 85 per cent, of $1.65 \times 0.85 \times 13{,}500 =$ 18,933 lb., and the actual brake shoe frictional pull that will be exerted at the periphery of the wheel will be $18{,}933 \times 0.10 = 1{,}893$ lb.; and for the pair, 3,786 lb. If contact with the rails is lost for a distance of 33 in., or 2.75 ft., then the work done on the wheel while thus out of contact will be $3{,}786 \times 2.75 = 10{,}412$ ft.-lb.

When the wheels again come in contact with the rail at the end of the 33-in. non-contacting space their peripheral velocity will be approximately 85.5 ft. per second, or about two feet less per second than the speed of translation. Here then it may be seen that the very small depression of 1/64 in. will, under the truck brake conditions assumed, cause an incipient wheel sliding which, assisted by the various pull rods in the truck transferring weight from one pair of wheels to another, as is usually the case, will cause one or more pairs to slide.

Again when nearing the end of the stop, the truck equalizing spring remaining compressed, the critical speed instead of being 22 ft. per second becomes 7 ft. per second, or a little less than five miles per hour; so that the wheel sliding at the end of the stop, so frequently observed, and also the tendency of wheels, slightly flattened in previous stops to slide more easily in subsequent stops,

is satisfactorily explained by the compressed condition of the equalizing spring preventing continuous rail contact.

The intermittent contact and non-contact occurring in quick succession at high speed with the brakes heavily applied tends to cause rapid deceleration of peripheral velocity and, in consequence, cessation of the wheels' rotation. However, since the rotating energy of the wheels is an appreciable force and each wheel of the pair is running on a rail of its own both may not be out of contact at the same instant while the brake is acting, in which case the velocity of one wheel of the pair while it is out of contact with its rail may not be materially reduced by the brake action on account of the torsional transmission of rotative power from its mate, and of its own rotating energy. This would seem often to be the reason for freedom from slid-flat wheels in warm weather when track surface alignment is usually at its best.

During cold weather contraction of rails increases the joint spacing, and frost causes more or less additional unevenness in the rail surfaces; so that an emergency application or even a heavy service application made at high speed is very likely to cause injurious wheel sliding, flattening the wheels sufficiently to require their removal; not, of course, because the flats are long enough to cause dangerously severe rail punishment, but because of the annoying effect which the incessant pounding produces.

Comparing Figs. 5 and 6, which represent the clasp and the single shoe types of truck brake rigging, and by

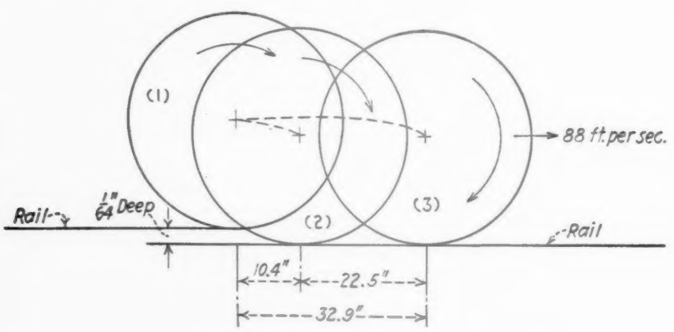


Fig. 7

(1) Wheel rolling into rail depression 1/64 in. deep.
(2) Distance of non-rail contact when equalizer spring is active, as shown in Fig. 4.
(3) Distance of non-rail contact when equalizer spring is held compressed solid, as shown in Fig. 5.

noting carefully the location of the brake shoes with respect to the wheel centers it can easily be seen that the vertical resultant of the shoe pressure, the relative magnitude of which is indicated by the length of the vectors *A*, is much smaller with the clasp than with the single shoe type; consequently, the clasp type will produce much less compressing effect on the truck equalizing springs than will the single shoe type; hence the clasp brake will maintain a more continuous wheel and rail contact during brake applications, and consequently there is less likelihood of injurious wheel sliding with the clasp than with the single shoe type of rigging on ordinary even surface track.

It is clear, therefore, that for the best possible continuous rail and wheel contact with any given track and wheel condition, the truck brake rigging and the brake shoes single or clasp, should be non-spring supported.

On modern freight equipment the truck brake rigging and the brake shoes are now quite generally non-spring supported, a fact which undoubtedly explains the almost entire freedom from injurious wheel sliding on freight equipment cars during brake applications made to control their speed; and if passenger and locomotive brakes were hung in a similar manner, the wheel sliding under heavy emergency applications on such equipment would be negligible, and consequently the brake efficiency could be considerably increased.

Conclusions

1—It is only for the ideal condition of rail surface with respect to evenness and for the ideal condition of wheel with respect to roundness that the coefficient of friction between the rail and the rotating wheel can be safely assumed, at speeds above the critical, to be constant in value and equal to that between the wheel and the rail when the car is motionless. Hence, all teaching respecting this point which tends to show that in practice it is, would appear to be in error.

2—Under all practical conditions of railway operation the pressure between the wheel and the rail will be variable or intermittent at all speeds above the critical, and it will vary during such speeds in quick succession between the normal maximum and zero, whether the brakes are or are not applied. If the depressions and elevations in the rail surface are of sufficient magnitude, then at high speed the non-contact rail spacing is longer than it is at low speed; hence there is a strong likelihood of wheel sliding at the higher speed during heavy brake applications.

3—If either type of truck brake rigging, single or clasp, be hung below the equalizing springs, these springs will remain as active during brake applications as they are during release; hence during brake applications the wheel and rail contact will be maintained as nearly continuous as the track condition will permit, and wheel sliding due to the brake action will be negligible with either type.

4—It being a fact that wheel sliding rarely occurs under freight equipment cars, which have the truck brake rigging non-spring supported, during brake applications made to control their speed, it is evident in connection with what has been explained in this article that a like result might be achieved for passenger equipment cars if their truck design were modified so as to provide for the non-spring support of the truck brake rigging.

5—Furthermore, the objectionable recoil of passenger trucks at the stop release of the brakes, because of the action of the brake shoe hanger in compressing the equalizing truck springs, would be eliminated, thus making for smooth stops as well as for freedom from flat wheels.

Numerous minor points which have an important influence on wheel sliding have not been touched on, but it is believed that sufficient has been said to show the important function which the truck equalizing springs and a track surface free from irregularities have to perform in efficient braking.

THE TOTAL NUMBER of locomotives, passenger coaches and freight cars built and purchased by the four groups composing the railway transportation system of Great Britain during the years 1923 and 1924, according to statistics received by the Bankers Trust Company of New York through its British Information Service, were as follows:

	Year	Built in the Companies' Shops	Purchased
Steam Locomotives....	1923	232	28
	1924	231	241
Passenger Coaches....	1923	543	29
	1924	784	71
Freight Cars	1923	17,200	4,521
	1924	26,797	6,777

The figures include a certain number of units purchased from other companies, etc., and in particular 125 locomotives purchased from the government in 1924.

Proceedings of the Fuel Association convention

Program included much of value to mechanical and operating officers—Reports of interest to former given below

A LARGE and varied attendance, which closely followed the proceedings throughout the sessions, characterized the seventeenth annual convention of the International Railway Fuel Association at the Hotel Sherman, Chicago, May 26 to 29, inclusive, as was indicated in a brief account of the meeting which appeared on page 373 of the June issue of the *Railway Mechanical Engineer*. A heavy, but well-balanced program in which was included papers and addresses of exceptional value to mechanical, operating and purchasing officers was carried through on a well-maintained schedule during the three days allotted for its completion.

The opening address of L. F. Loree, president, Delaware & Hudson appeared in last month's issue. Mr. Loree's address was followed by that of President P. E. Bast, fuel engineer, Delaware & Hudson. In the following columns will be found abstracts of Mr. Bast's address, of an address by John Purcell, assistant to vice-president, A. T. & S. F., and of several of the papers and addresses of particular interest to mechanical department officers.

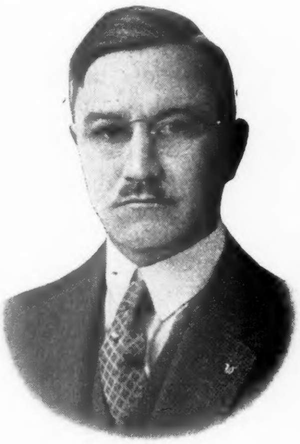
President Bast's address

In reviewing the activities of this association since its inception 17 years ago, its work has been mainly of an educational character, endeavoring to present the fuel problem through its various angles to the personnel of all departments on the railroads, with a view of having them realize their responsibility in the purchase, inspection, weighing, distribution, handling, use and accounting of fuel, all of which in the end result in the greatest possible reduction in fuel costs.

We all realize the magnitude and importance of the fuel problem; it is creative work and requires initiative, ability in engineering, organization and management persistently applied. However, it is gratifying to observe that since the question of fuel conservation has been aggressively taken up by the railroads and by this and other associations, consistent progress has been made in the reduction of the amount of fuel used per unit of work in the various classes of service. In this respect we can feel justly proud of the results obtained, which reflect the excellent work on the part of management, mechanical, transportation and other departments, and all employees and others, who have contributed their share to the economical utilization of fuel. We should not lose sight of the fact that fuel conservation is an economic necessity and has far reaching direct value, not only to the railroads but to the country in general.

In this room one year ago R. H. Aishton, president of the American Railway Association, in addressing our association emphasized the importance of the saving of one pound of coal per unit of work in the combined classes of service and made us realize as never before the splendid economies that would acrue to the railroads through such saving. His address gave us a new and fuller sense of our responsibilities toward the railroads and those they serve. Our association at that time, through its officers, pledged itself to effect this saving during the ensuing year. A poster featuring this pound of coal was distributed by this association over the various railroads. The response was far beyond our expectation.

I estimate that 77 per cent of the fuel used is in freight and passenger service. Applying the known ratio of saving in these services to switch and miscellaneous service the total savings in all classes of service from efficiency alone during 1924 compared with 1923 was 10,647,000 tons, or a money value based on the average cost of fuel per ton during 1924 of $32,250,000. These



P. E. Bast (D. & H.) president

J. W. Dodge (I. C.) vice-president

E E. Chapman (A. T. & S. F.) vice-president

W. J. Tapp (D. & R. G. W.) vice-president

splendid savings are based on increased efficiency and only tell part of the story, since the major savings of the railway fuel bill were accomplished through reduction in price. For instance, in 1924 the railroads saved a total of over $93,000,000, of which 65 per cent was due to price. During the first two months of 1925 compared with the first two months of 1924 the railroads are showing a further saving in about the same ratio. Unless the economic conditions of the bituminous coal industry improve, I am concerned whether or not the railways of the United States will be able to maintain the splendid savings in fuel cost which they have enjoyed during the past two years.

While we have contributed a share in the economical and efficient use of fuel, much remains to be done. Many promising opportunities await the activities of our association by advancement of information on the fuel problem, such as through the medium of illustrated bulletins, the distribution of fuel performance statistics of the various railroads, the establishment of an economical figure in fuel consumption in the various classes of service, all of which would have a stimulating effect in creating an interest that is so vital in further solving a problem of such importance as that of railway fuel.

We are living in an age of progress and advancement. It is my hope that our association will continue to advance and prosper and that in the near future conditions will permit the working out of a plan for the endowing of a scholarship annually for the benefit of worthy young men to pursue courses in engineering and combustion.

Fundamental fuel factors

By G. M. Basford
G. M. Basford Company

To produce maximum ton-miles per hour per locomotive, per unit of total cost is the task of today. This means moving more tons faster and cheaper. It means improvement of the locomotive as a power plant to the upper limit of our knowledge, experience, vision and courage and then immediate replacement of wasteful locomotives with money-making locomotive power plants.

Hauling heavier trains faster increases the speed of operation. Increasing average freight speed increases the capacity and economy of operation of the road. It defers additional tracks. It demands high horsepower which can be and must be had at lower cost. To provide high cylinder horsepower is comparatively easy. To supply enough snappy steam for continuous high cylinder power was the problem that waited for years to be solved.

Careful attention has been given to the development of capacity for starting heavy trains. Splendid results have been obtained. This has been far from mistaken policy. The work done to raise the starting end of the drawbar-pull speed curve revealed the need for and opened the way to raise correspondingly, the speed portions of the curve.

The locomotive as a whole

Study of locomotives recent and less recent, indicates no lack of engine horsepower, but a real deficiency in steam making power, compelling wastefully high rates of combustion. Resort to double heading frequently comes from the need for two grate areas rather than two sets of cylinders. We face again the same problem that we faced 30 years ago. Then power at speeds was had at the expense of high rates of combustion and at best was limited by grate areas. This brought wider fireboxes. Heavy back ends of boilers brought the trailer truck. Rates of combustion are again excessive. Greater power at speeds is needed and additional weight accompanying larger grates must be divided between two trailer axles. The four-wheel trailer unit was developed by combustion engineers to remove the limit to further locomotive furnace progress, which means the limit to further locomotive progress.

It is fortunate for fuel conservation that more thought is concentrated on improvements in locomotives as complete units than ever before. A change has come. Standards have been raised. Lima Locomotive Works has produced startling results in its development of the 2-8-4 type. The American Locomotive Company has brought forward the three cylinder principle. The Baldwin Locomotive Works is engaging its great resources in locomotive improvement, including development of the Diesel locomotive. J. E. Muhlfeld has worked out high boiler pressure combined with compound cylinders and the water tube firebox. One of our great railroads is operating 600 locomotives with marked fuel economy by aid of limited full gear cut-off.

Single factors for fuel efficiency are numerous and very important. Space permits only brief comment on some of these elements for co-ordinated design for high power with fuel conservation.

Steam making improvements

High steam pressures promise great economies. Pressures of 250 and 350 lb. are used successfully with promise of higher pressures as water tube fireboxes develop.

Low rates of combustion are necessary. Rates on big engines today run to 150 lb. and over. This is wasteful and calls for larger grate areas to reduce this figure one-half.

Higher superheat means greater economy. It reduces the work of the boiler by improving the economy of the cylinders. Superheated steam for auxiliaries greatly reduces the drain on the fire. This economy is equivalent to increasing boiler capacity about four per cent.

Gas velocities are high. It is important to reduce them by increasing gas areas through the flues as much as fixed limits permit.

Air admission to ash pans needs careful attention. A firebox is often filled with gas over six times per second. Restriction must be avoided and spark loss must be reduced. Ash pans need about a cubic foot of capacity per square foot of grate area. Only one engine with adequate grate area now provides it.

Steam separators to remove moisture from the steam on its way to the superheater merit attention for the sake of economy. As boilers grow larger it is difficult to provide steam space for the enormously increasing volumes of steam used. It is correspondingly important to relieve the superheater of double duty, evaporating water that goes over and also superheating the steam.

The possibilities of pulverized coal as a conservation factor should not be overlooked. The use of lignite and other low grade and low cost fuels is a promising field for further development.

Steam using or cylinder improvements

Expansive use of steam in freight service may be provided by design that limits the full gear cut off. This not only saves fuel at low speeds; it results in significant increase of capacity at higher speeds. It does not involve any mechanical complication whatever. It provides additional tractive force at low speeds because it smooths out the torque curve in starting.

"Cut-off" in locomotive operation requires more attention by fuel officers than it has ever received. There is a correct, economical cut-off for every different speed of the engine, one that develops maximum power for minimum

steam at every different speed. Until recently this has been left to guess work on the part of the engineman and no two men will adjust the cut-off over a division in the same way. Perfection of power reverse gear mechanism has opened the way to large savings in properly taking advantage of steam expansion as an economy and power increasing factor. But it is necessary to indicate to the engineman the proper adjustment to be made. Cut-off adjustments have also been made automatically, controlled by the back pressure.

Trailing wheels temporarily used as tractors in starting and in helping over hard pulls reduce fuel cost per unit of work done. This principle aids greatly at the low speed end of the drawbar pull-speed curve, and in facilitating acceleration. It permits of greatly increasing ton miles per train hour by increasing operating speed. It reduces the length of time an engine (without limited cut-off) must be "full stroked" in starting and helps every engine in accelerating. It is a capacity increaser and a fuel conserver.

Machinery improvements

Many locomotive parts are unnecessarily heavy. Cast steel cylinders saved two tons in the Lima 2-8-4 type engine. Unnecessary weight restricts the weight of the boiler and robs it of some of its capacity. Weight saved in reciprocating parts reduces dynamic augment and opens the way for greater static weights on drivers.

Between lubrication and fuel there is an important relation. It is estimated that the difference in fuel required to haul a freight train of 60 cars over a division at usual freight train speeds with high grade and lower grade oil is as great as 200 lb. of coal per hour.

With the designers of locomotive power plants ready in all respects, there is no real reason why a freight engine should not be coupled to a train, haul it 1,000 miles or more, uncouple, spend 24 hours in the hands of good men who are fully supplied with facilities, return for 1,000 miles, ready to do it over again and over again. For years the Rhodesian Railway in Africa has operated freight engines 700 continuous miles with sleeping and cooking facilities in special cabooses for the crews. Their trains are slow. It should be easier for us to make long freight runs.

Of very great importance is the switch engine policy of the road. This subject merits a thorough discussion of its own. It is a combined question of machinery and of operation, both sides of it affecting lots of fuel. On a busy, congested road switch engine mileage may be as great as 25 per cent of total locomotive mileage. This suggests the best of fuel conservation attention applied to switching engines. It is financially foolish to use old road engines for switching service. Railroads perpetuating this practice have no license to urge their men to save fuel.

Operating improvements

Fuel officers are in position to aid greatly in the substitution of train direction by signal indication and in the abolition of the time killing train order, especially the "31" order that stops a train in order to tell it to proceed, also the "19" order that slows the train down for the same purpose. A slow down to a speed of 8 to 10 miles per hour is nearly as costly as a stop. Both of these orders must give place to operation by signal indication.

Fuel officers and division superintendents, signal officers and train dispatchers will profit greatly by the closest co-operation to reduce losses in getting trains over the road. Long locomotive runs, main trackers, the "peg" and "turn around" plans, are playing a big part in fuel records. The load rating of locomotives offers another and too often neglected field for fuel conservation. Distribution of power offers still another. The distribution question is greatly simplified in the case of locomotives capable of hauling with economy a wide range of traffic.

Water purification is distinctly an aid in operation. It is obviously important to provide proper water for power plants of any kind, particularly those intrusted with the handling of money making traffic. One of the railroads leading in long locomotive runs has given unusual attention to this water problem and has found it possible to reduce by 25 per cent the number of locomotives assigned to traffic involving long runs. It is reported that the largest investment involved in its long runs, is in facilities for improving its waters. The annual saving effected amounts to approximately 75 per cent on the total investment in those facilities. In the matter of increased firebox life the service of its fireboxes has been doubled in less than ten years.

Knowledge of what we are doing

Lack of definite knowledge of the operating possibilities of improved locomotives has done more than any other one thing to retard the progress of the locomotive and the improvement of the locomotive power plant. To be efficient, transportation demands test plant tests for engineering data as the basis of locomotive design and complete road tests for operating data as the basis for financially profitable locomotive operation. The American Railway Association needs a test plant. Every railroad of even fair size needs a dynamometer car more than it needs any other factor in operation. Locomotives have improved not because of exact road operating performance records and facts, but in spite of a lack of them.

Co-operation

Real fuel conservation will be accomplished when and where there is real co-operation, when a very high official compels it. An officer, in position to do so, will ask: "Is our locomotive policy right, our car policy, our maintenance, our yards, our locomotive terminals, our side tracks, our signals and our operation?" Every one of these affects every other one and every one affects fuel. They can be best answered affirmatively by co-operative concentration on one thing—Fuel.

Discussion

In presenting his paper Mr. Basford referred to the performance of the 2-8-4 type locomotive recently built by the Lima Locomotive Works, Inc., and now in service on the Boston & Albany. This locomotive, he said, had recently handled a train of over 9,000 tons in 124 four cars over a 134-mile division with comparatively level grades, except for two pusher grades at an average speed of 18 miles an hour. This run was made with an average rate of combustion of less than 60 lb. of coal per square foot of grate per hour and with an average evaporation of over 8 lb. of water per lb. of coal as fired.

A. W. Perley (O.-W. R.R. & N.) in speaking of the improvement in fuel consumption to be obtained from modern locomotives and other economy devices said that he did not question their value but that the financial problems involved were serious and could not be overlooked. He cited the case of some of the Northwestern railroads where 98½ per cent of all money raised for capital expenditures during recent years had been by the issuance of bonds. Harrington Emerson was inclined to disagree with Mr. Basford's statement that gas velocities are too high. He called attention to the scouring effect of the gases at high speeds which maintains the heating surfaces in a more effective condition for heat transfer than would be the case were the gases to travel at low velocities. He raised the question as to why smaller and thinner tubes

could not be developed with the prospect of more efficient heat transfer.

A. Lipetz (American Locomotive Company) agreed with the principles set down by Mr. Basford. He said, however, that the locomotive has been so far perfected in the last 25 or 30 years that further perfection is possible only in a very small degree and that when we hear of improvements giving 25 or 30 per cent saving in fuel, the comparison is probably made with an obsolete or very imperfect locomotive. Mr. Lipetz classified the overall efficiency of the locomotive as the product of the efficiencies of the boiler, the cylinders and the transmission. He then analyzed the possibilities for improvements in each of these separate efficiencies. He placed normal boiler efficiency of modern locomotives at from 70 to 78 per cent where coal is burned and around 80 per cent where oil is the fuel used, and expressed the opinion that efficiencies much higher than 75 per cent in coal-burning service and 80 per cent in oil-burning service were not likely to be reached, this referring to the internal processes of the boiler itself and not to the possibilities such as that offered by feedwater heating which may be as high as 14 per cent through the reclamation of waste heat. Going to the cylinders, he placed the efficiency of the engine at about 10 per cent, non-condensing, stating that with saturated steam the highest possible efficiency, according to Rankine's cycle, is 15.5 per cent at 30-per cent cut-off; 12.7 per cent at 50-per cent cut-off, and 10.3 per cent at 70-per cent cut-off, which would be slightly higher for superheated steam. On this basis he expressed the opinion that the highest efficiency of the cylinders likely to be obtained with all possible improvements would not be more than 12 per cent with the present reciprocating non-condensing engine. As to the efficiency of transmission, this, he said, is already about 95 per cent, which offers little possibility for further improvement, and his conclusion was that the possible overall efficiency would not exceed 10 per cent, which is a small increase over the efficiencies of locomotives already built of between 8 and 9 per cent.

The important principles through which this improvement may be made, according to Mr. Lipetz, are to keep the cut-off low, to have as uniform draft as possible and the combustion rate as low as possible, the latter requiring the use of large grate areas which practically must be limited to a compromise between the possibilities for economy in operation and the possibilities of high stand-by losses when the engine is not working.

Mr. Lipetz then referred to the Russian Decapod locomotives built during the European war, about 200 of which were placed in operation on various American railroads. These locomotives, he said, employ exactly the features advocated by Mr. Basford, the cylinders being large so that running cut-off would not usually exceed 30 per cent and the engines would slip at a little over 50 per cent, which automatically limited the cut-off to 50 per cent without any actual mechanical limitations. The grate area of 64 sq. ft., he said, was large in proportion to the size of the boiler, although these locomotives were designed for slow speeds on light rails and were, therefore, not mechanically adapted to the heavy service conditions of American railroads. Because of the proportions referred to, however, he said that they have been found to be exceptionally economical in the use of fuel.

Considering the fact that the modern American locomotive has already closely approached the allowable clearance limitations, Mr. Lipetz raised the question as to how the larger cylinders required by the limited cut-off principle were to be incorporated and also how the maximum uniformity of draft so desirable is to be obtained. He expressed the opinion that the three-cylinder locomotive with its cylinder volume divided and its softer and more frequent draft impulses offered the best opportunity to meet these requirements and that, furthermore, the desirability of decreasing dynamic augment is also satisfied by this type.

How can a mechanical officer effect fuel economy?

By John Purcell

Assistant to Vice-President, Atchison, Topeka & Santa Fe

The cost of fuel has more than doubled in the past ten years and has reached a point where it is the greatest item of expense next to wages. The chief mechanical officer is responsible for maintaining the locomotives in an efficient condition at a minimum cost, and with the increased cost of fuel, certain features that have to do with locomotive maintenance effecting fuel economy will require particular attention.

For many years the mechanical officer has maintained his power by doing the work reported by the enginemen and inspectors. Such appurtenances as cylinder packing, valve rings, superheater unit, steam pipe and nozzle stand joints, grates, smoke box air leaks and stopped up flues were not given attention unless the locomotive was reported as not performing properly. The waste of fuel that takes place between the time a locomotive is in first-class condition and the time it is reported not steaming is of considerable consequence. This has resulted in many roads resorting to a monthly inspection of these features in order to reduce the fuel consumption. This inspection and the necessary repairs are usually handled at the time of monthly boiler inspection and, in addition to the fuel saving, this inspection results in decreasing the number of engine failures and in the locomotives giving better service on the road.

Two problems of the mechanical officer

The average life of a locomotive has been approximately 30 years of service, and on some territories the modern locomotive consumes $30,000 worth of fuel per year, or $900,000 worth of fuel in the life of the locomotive. From the trend of fuel costs in previous years, it can be expected that the cost will continue to increase. The chief mechanical officer is confronted with two important problems dealing with fuel conservation, one being to make existing locomotives more efficient, the other to design locomotives which will render efficient service on the territories where the locomotives are to operate.

There is a field for reducing the fuel consumption of existing locomotives by the application of superheaters, feed water heaters, brick arches, increasing steam pressure, improved front end arrangements, elimination of smoke box air leaks, closer fitting grates, and by application of larger tenders which will reduce the number of stops on the road and eliminate taking water at some of the bad water points on the division. These features may be taken care of with a relatively low capital investment and should be given thorough consideration. The useful life of existing locomotives may be prolonged by these additions and betterments, making them useful and efficient units of increased capacity. The service that existing locomotives are to perform in future years should be studied, and where the capital is available, locomotives should be equipped with fuel saving devices of proved merit which will give a net saving for the application. Complications on account of weight distribution on some of the existing locomotives will be found a limiting factor.

The application of devices on new locomotives is less complicated. The locomotives being built each year secure a greater efficiency in the use of fuel. The thermal efficiency of locomotives built in 1900 was approximately five per cent, while locomotives are being built today that have a thermal efficiency of eight per cent. These per cents were secured from test plant results and show an increase in efficiency of 60 per cent in 25 years. Definite progress is being made to reduce the fuel consumption of the locomotive, and developments may be expected in the future that will further improve its efficiency. Experimental work is being done to reduce fuel consumption by use of water tube type of fireboxes, steam pressure as high as 350 lb., three-cylinder construction, 50 per cent cut-off, and the Diesel locomotive.

The need for reliable tests

Any fuel saving or capacity increasing device will make the locomotives more complicated and increase the cost of maintenance, which must be offset by an increase in the economic value of the locomotive. The chief mechanical officer is confronted by claims of low maintenance and high fuel saving for different devices that are startling. Many railroads do not have equipment accurately to test out these devices, with the result that reports of tests are being furnished which are not representative of the net saving that can be realized from the different applications. The American Railway Association is investigating the advisability of having a centralized testing plant for securing accurate and unbiased results for the member roads. Such a plan will be of great assistance to roads not provided with test equipment and organization for handling test work, and will have a far reaching effect in reducing fuel consumption.

Proper maintenance and operation are necessary to secure the greatest net saving on investment from fuel saving or labor saving devices on locomotives. The purpose of these devices is to reduce fuel consumption and without proper maintenance and operation this purpose can be entirely defeated and may result in a fuel loss.

The assignment of power suitable for the service to be performed is an important factor in fuel economy, and is equally important in cost of maintaining locomotives. The grades, average speed, character of business both present and future, quantity of fuel and the available boiler feed water must be considered. A thorough study of these conditions and careful methods of arriving at tonnage ratings of new as well as old locomotives is necessary to assign power intelligently to produce a minimum fuel consumption per unit of work.

A uniform quality of fuel should be furnished over the entire territory to which the locomotive is assigned. Tests should be made to determine the relative consumption per unit of work for each different fuel that is available. The best fuel from the standpoint of consumption and cost should be used. A good quality and grade of fuel is desirable but is not as essential as having a uniform quality of fuel. Good results are being secured from inferior qualities of fuel where it is uniform and the locomotives drafted for that particular fuel.

Better locomotive utilization saves fuel

The utilization of locomotives has been materially increased in the last ten years by the general pooling of power, and in more recent years by extending locomotive runs. It is questionable whether the pooling of power resulted in any fuel saving, but the extended locomotive run over several operating districts, or the quick turn-around on single operating districts without knocking the fire has resulted in fuel saving as well as decrease in maintenance cost. The limiting factors on how far the locomotive can run before requiring roundhouse attention are the design of locomotive, quality of fuel, quality of boiler feed water, character of business and facilities for maintaining the locomotives. It has been found economical and practical to run passenger locomotives from ten to twelve hundred miles without roundhouse attention by having turn-around attention at the end of half of this mileage. Locomotives in through freight service are being operated for distances from three to five hundred miles without roundhouse attention, with an equal measure of economy. This operation eliminates the fuel consumed at intermediate terminals and greatly reduces boiler maintenance costs on account of relieving the boiler of the severe strain caused by expansion and contraction in cooling down and firing up.

While the chief mechanical officer can assist materially in the conservation of fuel by keeping his locomotives in first class condition, the enginemen and firemen can also assist very materially in reducing fuel consumption. I had an opportunity sometime ago to review the performance of 18 passenger locomotives of the same type and size, running in pool service and handling the different trains on a 200-mile division. The report shows the performance of each individual engineman and fireman, as well as each locomotive. The amount of fuel consumed varied, on the same locomotive and same train making the same number of stops, under the same weather conditions, as much as 15 per cent. The best performance was accomplished by the proper operation of the throttle and reverse lever; also lubrication, good firing practices, avoiding waste of steam through pops, and the height the water was carried in the boiler.

It is possible for the best maintained locomotive and the best trained engine crew to show a poor fuel performance if the train is not moved at an economical speed, or if the train furnished by the transportation department does not utilize the capacity of the locomotive. These transportation features are as important in fuel conservation as the design, maintenance, assignment or efficient operation of locomotives, which are the direct duties of the mechanical officer.

Report on boiler feed water heaters

The committee is able to report a very substantial gain in the number of feed water heaters applied and on order as of May 1, compared with previous years as follows:

Year	Feed water heaters	Exhaust steam injectors
1920	7	..
1921	54	..
1922	234	..
1923	1,429	..
1924	2,123	24
1925	2,551	37

This remarkable gain in the past few years is conclusive of the practicability of the feed water heater.

Closed type feed water heater

Since the last report of this committee, important developments for the closed type feed water heater equipment have been three in number as follows:

1—Development of a duplex feed pump of smaller size, but larger capacity and smoother action compared to the original simplex type.

2—Perfection of means for preventing accumulation of scale in the heater.

3—Protection of the heater equipment against any possible corrosion, electrolysis or action of acid used in washing.

The new type of boiler feed pump developed by the Superheater Company with the Elesco closed type feed

water heater is known as the constant flow type. This is of the duplex arrangement wherein steam distribution is so arranged that the movement of the two pistons is the same as if they were connected to cranks set at 90 deg. angles so that with one piston at the end of the stroke, the other is at that instant at mid-stroke, thereby insuring that when one piston is reversing the other is delivering a steady stream of water. Thus a steady regular flow of water is produced, which insures keeping the boiler check off its seat while the pump is in operation.

This pump is capable of discharging 10,000 gallons of water an hour against a pressure of 225 lb. There are now over 300 pumps of this design in service and it has been adopted as standard equipment for the larger sizes of Elesco feed water heaters.

Brief mention was made in the discussion of last year's report to the effect that methods were being developed which would prevent accumulation of scale in the tubes of the closed type feed water heater in bad water districts. It was explained at the time that this process consisted in the addition of a very small amount of a compound to the water in the tender, which acted as a protective colloid and would prevent the precipitation of scale out of the feed water until after it had passed through the heater. The compound used for this purpose is chestnut bark extract, a product commonly used by tanners. This is fed into the water in the tender in proportion of one part extract to about 100,000 parts of water. Tests have shown that some antifoaming compound regularly fed produces the same results.

Experiments have been carried on during the past year in the district where the largest amount of scale accumulated in the tubes of the feed water heaters. It has been found that it is possible to run heaters continuously in that district without cleaning, and without accumulation of any scale or other deposits in the heater tubes. Inasmuch as the most satisfactory results are obtained when the compound is added to the water in the proper proportions, a mechanism has been developed which will automatically measure and feed the compound whenever water is taken. It will normally cost about ¼ cent per 1,000 gallons for treating the water in this way, after the apparatus is applied. It is only recommended that the anti-scale treatment be used in cases where the heater requires washing each 30 days or less.

In certain districts some trouble has been encountered from corrosion from acid washing and electrolysis of feed water heaters, due to some unusual condition in the feed water. In order to prevent all troubles of this nature arrangements are now made to cover all steel or iron parts of the Elesco feed water heater that are touched by water, with a non-corrosive coating. It is the intention of the manufacturers to protect all feed water heaters in this way.

Open type feed water heaters

There have been purchased to date, by the railroads of the North American continent, slightly more than 1,400 open type feed water heaters. Operation of these units has gradually improved through the growing familiarity of the users with the construction and functioning of the apparatus, with the development of organized maintenance and with gradual improvement in materials and construction. The latter have included steps looking to the perfection of the steam valve gear and the water valve service and the selection of suitable materials for gaskets and pump piston and piston rod packings.

The Pennsylvania Railroad has released information concerning tests made on the locomotive testing plant of open type feed water heaters applied to their Decapods or 2-10-0 type locomotives in which they show that within the capacity of the feed water heater they credit a saving of 14 per cent as an average throughout its complete range. This is somewhat higher than has been previously reported by your committee, but this range could well be made with a coal burning locomotive where the coal rate per square foot of grate area is high and consequently reduces the boiler efficiency.

Cleaning of the open type heater, where necessary at all, and in all but the most exceptional cases, can be deferred to the general shopping date. Methods of cleaning, thus far resorted to, consist of scraping, washing, and the judicious use of the scale solvents on removable parts. Fully half of the installations thus far made are characterized by the omission of the oil separator from the exhaust steam line to the heater, this having been done at the option of the users, thus far, with no results that prompt them to question the correctness of this line of procedure.

Scale formation in the heater is confined mostly to the upper section of the heater, where, between shoppings, scale will form to a thickness of between one and two inches. In the lower sections of the heater, the formation of scale is not noticeable. These scale formations in the heater, however, do not affect the working or the temperature of the water delivered. Another troublesome scale formation is found in the atmosphere vent pipe from the heater, which has, at times, been entirely closed by scale, and when in this condition it reduces the temperature of the feed water as much as 15 or 20 deg. on account of the inability to get rid of the air in the heater.

Exhaust steam injectors

In the 1923 and 1924 reports of this committee, brief mention was made of the exhaust steam injector, and attention was drawn to some of its more prominent characteristics. The development of this apparatus to meet American conditions has progressed steadily during the last three years. The principal attention has been given to the perfection of an automatic control arrangement, making unnecessary the manipulation of a number of levers and valves for the proper operation of the instrument. Many of the older types have now been changed and all new ones furnished are equipped with the new control.

As now arranged the operation of this injector is simple and requires little attention on the part of the engineman. To obtain the most economical results it should be operated by adjusting the water regulator so as to meet the demands with the use of as little supplementary steam as possible. The amount of this supplementary live steam when the locomotive is in operation depends largely on the exhaust steam pressure and the temperature of the feed water. The injector has been known to work perfectly against 200 lb. boiler pressure with the supplementary steam shut off entirely when the back pressure was about 4 lb. and the feed water temperature was 45 deg. F. Injectors will handle feed water successfully up to 85 deg. F. temperature.

It is very important that the size of the injector be suited to the size and power of the locomotive.

Some figures are now available in connection with the cost of maintenance of the exhaust injectors. One road reports that the cost of maintenance for twelve months, from April 1, 1924, to April 1, 1925, on eleven injectors amounted to a total of $490. Of this amount $265 was for material and $225 for labor. This amounts to about $45 per injector per year, or $1.20 per 1,000 miles. These eleven engines made a total of 407,245 miles during this period.

The following quotations were selected as typical from various reports received by the committee:

"This device has given us about 5½ per cent reduction in water consumption with a proportionate saving in fuel since its installation in July, 1923. It is my opinion that when the mechanical imperfections we have found in the injector have been eliminated, it will show a saving of between 10 and 11 per cent in fuel."—Report dated April 5, 1925.

"Our experiences with this injector have been so satisfactory that we anticipate a considerable extension in the use of this device. Results of road tests made with very meagre test apparatus showed the exhaust steam injector to save about 7 per cent when compared with a non-lifting live steam injector."—Report dated April 10, 1925.

Inasmuch as such test data now available does not point to any definite conclusions the committee hesitates to give a general statement as to the savings which may be expected of the exhaust steam injector. The lack of determinate data can in part be attributed to the number of variable factors involved such as the use of both exhaust and live steam and to variations in efficiency which may occur at the various rates at which the exhaust injector is operated. It is established, however, that there will be a noticeable drop in back pressure and that the superheat will be lowered about 15 deg.

Feed water purifier

The Canadian National was experimenting with one locomotive equipped with a feed water purifier placed on top of the boiler so that the discharge from the feed water heater and injectors passed through it to the boiler but so much trouble was experienced that it was removed and within the knowledge of the committee there are at this time none in service in this country. This device is particularly applicable to waters which contain a great amount of carbonates and feel that this is a subject that should not be dropped by the American railways.

Feed water heating at terminals

Last year the committee referred to the fact, that approximately 20 per cent of all locomotive fuel is consumed at terminals, and presented some figures to show the effect on fuel consumption of supplying hot filling water for locomotives, where the filling water is heated by blown off water and steam that would otherwise be wasted. It was estimated that the possible fuel saving from this source amounted to from 1,500 to 2,000 pounds of coal for each locomotive filled.

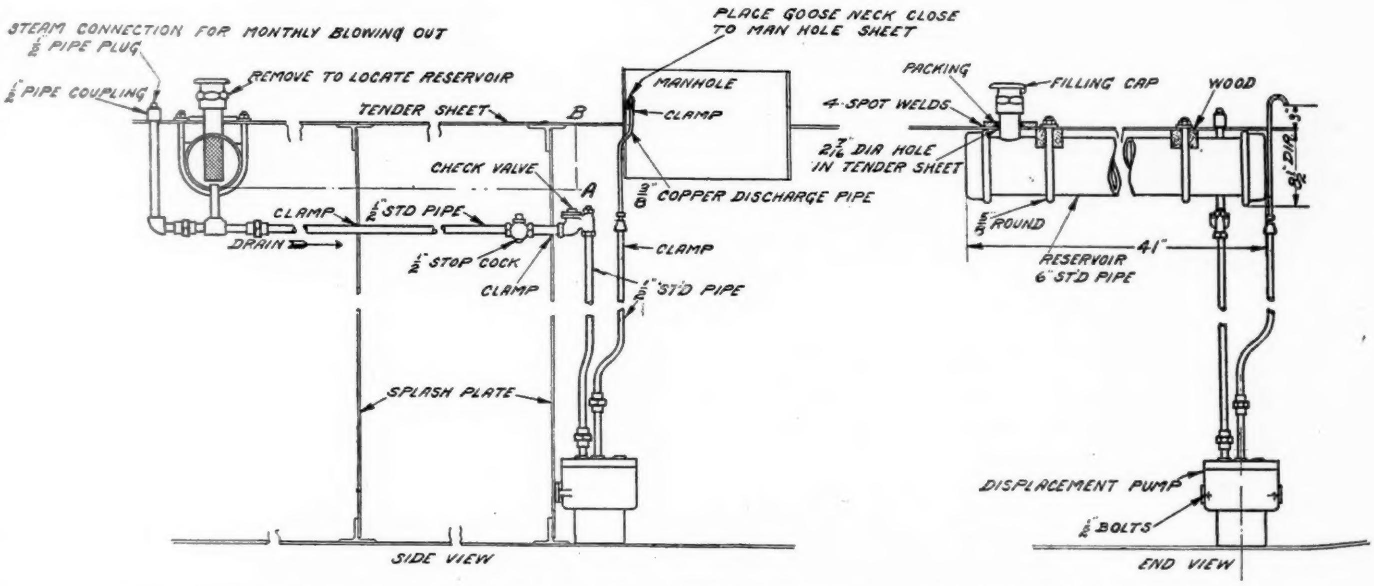
One of the factors in connection with the savings from boiler feed water heating at terminals is found in the reduction of steam blower consumption, resulting from the reduction in time required for firing up locomotives filled with hot water over the time required to fire up a locomotive filled with cold water. The test which will be described in more detail in subsequent paragraphs indicated that this saving in time amounted to about five minutes in the time required to steam up a locomotive for each 10 deg. increase in the temperature at which the boiler was filled. On this basis, it will require about one hour less to steam up a locomotive filled with water at 180 deg. F. than the time required to steam up a locomotive filled with water at 60 deg. F.

As the saving in blower steam consumption resulting from a reduction in the time required to steam up a locomotive depends upon the rate of steam consumption of the blower itself, the committee further undertook to investigate the situation with respect to the quantity of steam required for blower purposes. It is apparent from the replies received, that this phase of locomotive terminal operation has received very little consideration, and that the quantity of live steam ordinarily required for firing up locomotives represents a greater fuel loss than is generally appreciated. While no general conclusion as to steam consumption required for blower purposes can be drawn from the above, it is evident that the blower is a fuel consumer of sufficient magnitude to warrant careful attention.

In this connection some very interesting information was submitted by the Baltimore & Ohio on the use of a motor driven induced draft fan for steaming up locomotives. The following table shows the results of some tests comparing steam blower operation and an electrically operated fan.

These figures show up the cost of operating a steam jet in a very forceful manner. For practically the same conditions throughout, the fan was able to fire up a locomotive for a cost of about 3.7 per cent of the cost when using the steam blower.

The latest important development in connection with boiler feed water heating at locomotive terminals is the direct injection into the locomotive boiler of live steam



Measuring apparatus for automatically supplying cleaning compound to a locomotive feed water heater

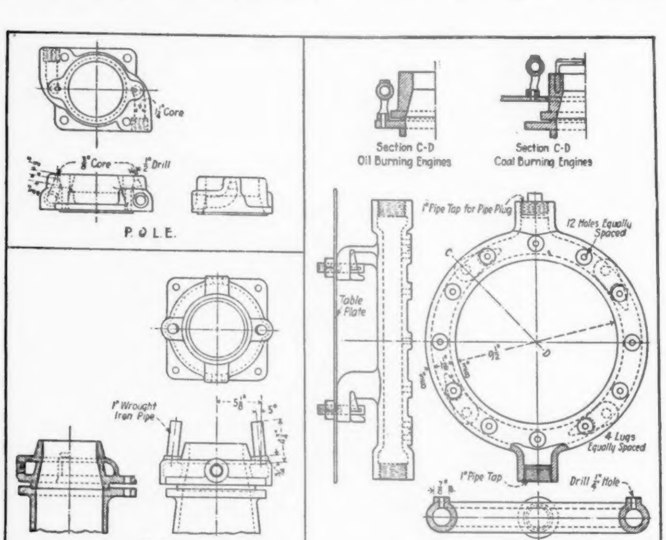
together with hot filling water for the purpose of reducing the time and fuel required to steam up locomotives. This method may also be utilized for steaming up locomotives to a working pressure without lighting the fire, for the purpose of eliminating smoke and blower steam in the engine house. In addition to the economy to be gained from filling with hot water, the direct injection of live steam generated in an efficient stationary boiler requires less fuel than the same amount of steam generated in the locomotive firebox during the firing up period. The reduction in blower steam required with this method represents a further fuel saving.

Data relating to electric blowers for firing up locomotives in enginehouses

Abstract from tests conducted September 26, 1923, on a Mikado locomotive.

Items	Fan	Steam blower	Difference
Kind of coal used	R.m. gas	R.m. gas	....
Kind of kindling used	Fuel oil	Fuel oil	....
Average temperature of water at start, deg. F.	72	76	4
Pounds of coal on grates at start	1,212	1,206	6
Pounds of coal fired during test	690	681	9
Total coal used, pounds	1,902	1,887	15
Draft in smoke box, average, in	0.84	0.81	0.03
Kw. hours used	4.03	......	....
Pressure on steam blower line, lb. per sq. in.	....	85.5	....
Pounds steam used per hour	....	2,452	....
Pounds of steam needed to draft locomotive	....	2,800	....
Area of blower nozzle tip, sq. in	....	0.87	....
Time to get 1 lb. per sq. in. steam pressure after light-off, min	43.0	47.0	4.0
Time to get 65 lb. per sq. in. steam pressure after light-off, min	66.5	68.0	1.5
Cost to draft locomotive	$0.062	$1.682	$1.62
Cost per 1,000 pounds of steam	....	0.60	....
Cost of power per kw.-hr	.0154	......	....

The equipment required for direct steaming is the same



Typical examples of locomotive blower nozzles—The P. & L. E. reports that it requires about 16 boiler hp. per hr. to operate the blower shown in steaming up locomotives—The A. T. & S. F. reports steam consumption of about 30 boiler hp. per hr. to operate the blower shown for steaming up oil burning locomotives—The N. P. reports steam consumption of 50 boiler hp. per hr., with the nozzle shown in steaming up coal burning locomotives

as for blowing off locomotives and for washing and filling locomotives with water heated by the blown-off steam and water, with the addition of a live steam main from the power plant with connections to each filling drop. With these connections the usual procedure would be to attach the blow-off valve to the combined blow-off and filling connection as soon as the locomotive is placed in the engine house. If the boiler is to be washed or water changed, the contents are blown off through this flexible connection. When ready to fill, both the filling and live steam valves are opened. The hot filling water and live steam combine in a booster connection and enter the locomotive boiler at a temperature considerably over 212 deg. As soon as water shows in the glass, the hot water valve is closed and the flow of live steam continued until a working steam pressure is built up in the boiler.

This practice was referred to in the previous report in connection with the subject of feed water heating at terminals and several installations of the direct steaming system are now being made at new terminals so that a study of this method in regular operation will be available for the next report. For the current report, the most comprehensive data on this subject is found in the results of a series of tests on steaming up locomotives that was conducted by the Atchison, Topeka & Santa Fe during the past year at Newton, Kansas.

The following general conclusions may be drawn from these tests:

1.—The consideration of steaming up without fire implies the use of high pressure steam in power plants and consequent changes in order to obtain the desired speed in building up the steam pressure in the boiler, requiring the use of steam pressures of about 200 lb. and stationary plants built accordingly; also a system for filling at 180 deg. F. and above.

2.—A saving of fuel would amount to slightly over one gallon of oil, or its equivalent in coal, for each thousand gallons of boiler feed water used in firing up when heated 10 deg. F. by the utilization of waste heat.

3.—There would be an average saving of time of about 4 to 5 min. for each 10 deg. F. difference of feed water temperature.

4.—A saving of time would result from the combined filling, steaming and firing up processes, of 35 min. as compared with simple firing up with 180 deg. F. initial temperature. There should be a reduction of stand-by losses together with some reduction of smoke nuisance in roundhouses. The latter would, of course, be especially noticeable in case of coal burning locomotives.

The report is signed by E. E. Chapman (A. T. & S. F.), chairman; E. A. Averill (Superheater Company), Stanley H. Bray (S. P.), A. G. Hoppe (C. M. & St. P.), V. L. Jones (N. Y., N. H. & H.), John M. Lammedee (Worthington Pump & Machinery Corporation), L. P. Michael (C. & N. W.), Geo. S. Mikles (N. Y., O. & W.), Geo. E. Murray (N. Y. C. & St. L.), L. G. Plant (National Boiler Washing Company), John M. Snodgrass (University of Illinois), and H. W. Sefton (C. C. C. & St. L.).

Discussion

Considerable interest was shown in the steaming up of locomotives at terminals by the injection of live steam directly into the boiler after it has been filled with hot water. The question was raised during the discussion as to what effect this practice would have on expansion in various parts of the boiler, which brought out the explanation that with the injection of steam into the boiler the water is heated gradually throughout the boiler and that steam rises over the entire surface without overheating any part of the boiler. On the contrary when steam is raised from cold water by firing up the locomotive, the firebox is heated to a high temperature while the rest of the boiler is still cold, thus inducing unequal expansion strains.

T. C. McBride (Worthington Pump & Machinery Corporation), said that while the practicability of the locomotive feedwater heater is considered to be established, it should not be thought that development work is not still being done, and called attention to a number of

features in the open type heater which have recently been improved. Mr. McBride also expressed the opinion that the rating of the feedwater heater in terms of per cent of saving does not mean much because the actual saving depends on the amount of work done by the locomotive. He suggested that the reduction in the number of pounds of coal per hour effected by the heater in a given class of service would convey a more accurate idea of its economic importance.

R. M. Osterman (Superheater Company) gave some information concerning the possibilities of the exhaust steam injector from a feedwater heating standpoint which have been brought to light in the development tests of this instrument. He stated that the type of Metcalf injector in use on some foreign roads has effected savings of 3 or 4 per cent as compared with savings of 9 per cent with other types of heaters. He said that the tests in this country indicate no reason why the performance of the injector should be inferior to the pump type heater. The amount of saving, he said, depends on the quality of the injector which in this country has demonstrated its ability to pump against 150 lb. boiler pressure with 1 lb. exhaust steam pressure at 60 deg. superheat. He called attention to the fact that the exhaust steam injector must be carefully proportioned in its capacity to suit the capacity of the boiler which it is to supply with water.

C. W. Sturdevant (Southern Pacific) gave an interesting account of the results obtained on the Southern Pacific by the application of the Zeolite method of water softening on the Southern Pacific. In a stationary boiler plant at Los Angeles, he said, a water is used containing 14 grains per gallon, mostly of calcium and magnesium carbonates. Before using the treatment the feedwater heater would accumulate about 2 in. of scale and the pipes became plugged so quickly that it could not be operated longer than seven to eleven days without cleaning. Since the Zeolite treatment has been in use, the heater was operated six months when, on examination, no trace of scale was found. He said that the treated water had been introduced into locomotive service at Los Angeles and that no trouble with foaming had been experienced, whereas before treatment was introduced it was necessary to use anti-foaming compound on all locomotives as well as in the power plant. In answer to questions, Mr. Sturdevant said that the Zeolite material is a natural green sand, the action of which is essentially to effect an exchange of sodium for calcium. He said that the Los Angeles water would require about 1 lb. of lime and ½ to ⅝ lb. of soda ash per 1,000 gallons, which he estimated would cost about 2¼ cents per 1,000 gallons to treat. The cost of the Zeolite, he said, was about 1¾ cents per 1,000 gallons. The calcium and magnesium removed from the water, he said, are filtered into the sand, which is reconditioned by the periodical introduction of a salt bath at the rate of approximately ½ lb. of salt per grain of hardness per 1,000 gallon of water treated. One advantage of this treatment which he mentioned is the fact that the water can be used for drinking purposes.

Mechanical means for cleaning locomotive flues

By C. B. Smith

Mechanical Engineer, Boston & Maine

The importance of clean metal on both the fire and water surfaces of boiler flues, as well as of firebox plates, needs no argument before the members of this association. The slow accumulation of encrusting solids upon the water surfaces calls for periodic cleaning not less frequently than once a month.

In extremely bad water districts additional means for scale prevention by water treatment are necessary and are practiced by different methods, depending on the chemical nature of the water. In eastern territory water taken by locomotives is usually fit for boiler purposes. Although there are occasional points where relatively bad water must be taken either on the trip or at one terminal, water treatment is not generally regarded as warranted. It is difficult, under such conditions, to show an economy from the investment for boiler compounds. In such territory the gradual accumulation of scale on the water side of boiler plates is certain to occur between class repairs, somewhat reducing the efficiency of heat transmission during the service period of the locomotive. According to Kent, "The influence of scale on heat transmission in locomotive boiler tubes" may vary from 2 to 19 per cent decrease in conductivity. Tests indicate 4 to 6 per cent as representative.

The tubes and flues provide the passage for gases from the furnace and if not kept reasonably free from the accumulation of soot, ash and clinker, to permit sufficient draft for proper combustion, a steam failure will result. Hence the importance of systematic flue cleaning, performed as frequently as the character of the coal requires.

It is not uncommon to dump locomotives for flue cleaning once each week. The cycle of operations include:

Dumping fire.
Removal of required number of firebrick—usually the center rows.
Inspection with an open-flame torch.
Labor of blowing flues and tubes, punching out solid deposits when necessary. Washing with water is also practised by some roads.
Restore firebrick, replacing broken bricks by new bricks—usually 50 per cent of new bricks are required.
Rebuild fire.
Restore steam pressure.

The time required for this cycle of operations is about three hours, including from three-quarters to one hour for cleaning the flues and tubes. In our experience the cost of labor and material involved in this operation amounts to about $30.00 a month for each locomotive.

The writer has no figures on the loss of efficiency due to dirty and plugged flues, but it is obvious that this is cumulative from the time that a locomotive goes into service with clean flues until they are blown out again. Records which have been kept on two divisions show that plugging of flues frequently amounts to 10 per cent of the flue area. This refers to flues completely stopped up, no consideration in the reports being given to flues only more or less coated with soot.

For several years past the installation and satisfactory use of mechanical flue blowers in the rear connection of horizontal return tubular boilers in stationary service has led the writer to a favorable consideration of a similar device for locomotive boilers. Such a device was brought out a few years ago. The blower consists of a movable steam nozzle mounted on each side of the boiler and projecting into the firebox at a point above the arch and at a proper distance back of the tube sheet. To operate it, the nozzle is advanced into the firebox by the movement of a lever and then rotated by a hand wheel. These controlling handles are conveniently located in the cab. The opening in the nozzle is shaped at such an angle that when it is rotated a wide, flat, jet of steam is spread over the tube sheet. When the blowing operation is concluded the nozzle is drawn back into a water space thimble to avoid its being burnt. Steam is piped from the turret or other suitable point on top of the boiler and is preferably controlled by means of a quick-opening valve easily accessible in the cab.

As far as the writer knows the first locomotives in the United States to be equipped with this blower are being operated in New England territory and, as a re-

sult of the experiment, road locomotives built about two years ago were also equipped with it. In this lot were Santa Fe type locomotives having a grate area of 80 sq. ft. and equipped with a Gaines wall and a brick arch. These locomotives have been in constant service running with older locomotives of the same type and design not equipped with flue blowers. If the blowers are operated twice on each road trip, these locomotives do not have to be dumped for flue blowing between the monthly washout periods. On duplicate locomotives not equipped with blowers, it is necessary to dump the locomotives to clean the flues every seven to nine days. At the washout periods when careful attention is given to cleaning flues and tubes, it is found that, regularly there is little cleaning needed on the Santa Fe locomotives equipped with the blowers and they can be made ready for road service more quickly than the locomotives not equipped with blowers.

The other locomotives in this lot were the Pacific type in which it is standard practice to leave an opening between the tube sheet and the brick arch to prevent plugging of the lower rows of tubes by the accumulation of ash and cinders.

The coal used on these locomotives is uniformly low in ash and sulphur, about 36 per cent volatile and 14,000 B.t.u. It has a firm structure and runs about 35 per cent, 1¼-in. slack on the tenders, costing on an average of $5 a ton. The fusibility of the ash varies from 2,650 deg. to 3,000 deg. F.

The maintenance required by this equipment over a two-year period has been found to be very slight. At the monthly boiler washout the apparatus is inspected and the operating mechanism oiled. About once in six months the stuffing box of the blower nozzle tube may need repacking. There has been little or no trouble from the burning of nozzles.

Owing to the good results already obtained with these blowers we have started a monthly program for application of the device at class repairs to a considerable number of Pacific, Consolidation and Mogul type locomotives.

Discussion

This subject aroused much interest among those in attendance. The discussion brought out the fact that the New York, New Haven & Hartford has 43 locomotives equipped with flue blowing devices, and that one of these engines ran 90 days without having the flues blown at the terminal, after which only 17 tubes were found plugged, whereas formerly it was necessary to blow the flues every 10 days. Where engines are equipped with this device, it has been possible to place the arches against the flue sheets of switch engines, thereby reducing the smoke nuisance where this is a factor of importance. In answer to questions it was stated that the fireman is the best judge of the proper locations at which to operate the flue blower. Such locations should be selected where there are few houses and if this is done there will be no complaints because of the soot blown out of the stack. In one case where the flue blower is in use, it has been found by pyrometer readings that the superheated steam temperatures run from 650 to 670 deg. F., whereas 600 deg. F. is the best that can be maintained on other engines.

Other addresses and reports

Other addresses and papers were presented during the convention on the following subjects: Signals and the saving of fuel, by B. J. Schwendt, New York Central; How can railroad management effect fuel economy, by A. R. Ayers, New York, Chicago & St. Louis; How can fuel purchases effect fuel economy, by H. C. Pearce, Chesapeake & Ohio; Stocks, production and consumption of coal, by Mark Kuehn, National Association of Purchasing Agents; The development of oil-burning practice on locomotives, by J. N. Clark, Southern Pacific, and Back pressures as an index to fuel economy, by R. W. Retterer, Cleveland, Cincinnati, Chicago & St. Louis.

The following are the committee reports other than those abstracted herein which were on the program: Report on fuel accounting, distribution and statistics; report on firing practice; report on stationary power plants; report on Diesel locomotives; report on fuel stations. Abstracts of several of these reports will appear later.

Tests of Missouri Pacific three-cylinder Mikado

High boiler and engine efficiencies shown in performance on Altoona test plant

One of the three-cylinder locomotives recently built by the American Locomotive Company and described in the *Railway Age,* May 16, 1925, was a Mikado (2-8-2) type for the Missouri Pacific. Before this locomotive was placed in road service it was sent to the testing plant of the Pennsylvania at Altoona, Pa., and submitted to a thorough test. The results obtained are of particular interest due to the fact that this is the first three-cylinder locomotive of which complete tests have been made.

This locomotive weighs 340,000 lb. of which 244,500 lb. is on the drivers, and has a rated tractive force at starting of 65,700 lb., this making the factor of adhesion 3.72. The two outside cylinders are 23 in. by 32 in., the inside cylinder is 23 in. by 28 in., the boiler pressure is 200 lb. and the drivers are 63 in. in diameter. The leading weights and dimensions are given in an accompanying table.

The boiler is of the straight-top type, 88 in. in inside diameter and fitted with a firebox 114⅛ in. long by 84¼ in. wide. There are 199 tubes 2¼ in. in diameter and 45 flues 5½ in. in diameter, all 19 ft. long. The superheater is a type A with 1½-in. tubes, 17 ft. 11¾ in. long. The brick arch is carried on two tubes 3 in. in diameter. The grates are of the table type and the grate area is 66.8 sq. ft. The firebox is fitted with a Nicholson thermic syphon having two water legs. In addition, the barrel of the boiler is fitted with the Harter circulator which consists of a flat horizontal plate located at or about the mid-height of the boiler, extending nearly the full length

of the tubes and provided with steam outlet pipes leading up from the plate to the steam space near the top of the boiler. Coal is fed to the boiler by an Elvin stoker.

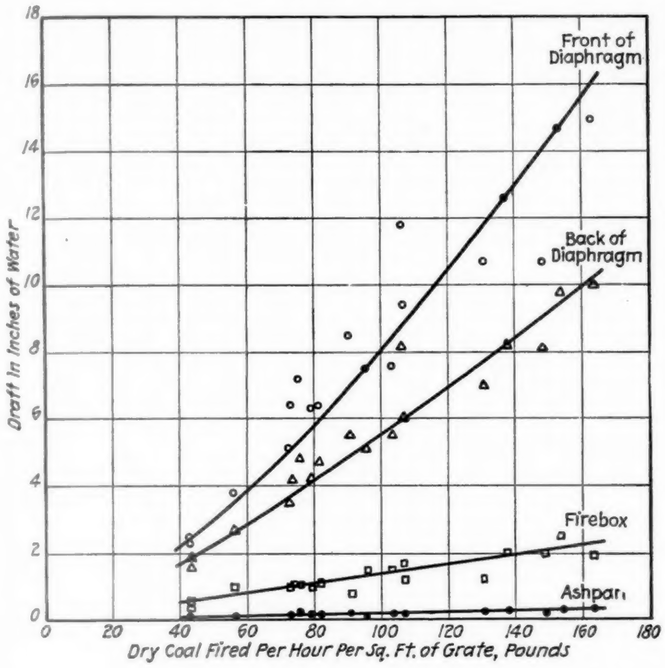


Fig. 1—Draft records for ashpan, firebox and smokebox

The heating and superheating surfaces are divided as shown in the table below:

Heating and superheating surfaces—sq. ft.

	Waterside	Fireside
Firebox, alone	268	271.3
Syphon	67	79.2
Arch tubes	14	15.5
Firebox, total	349	366
Tubes and flues	3,437	3,110
Total evaporative	3,786	3,476
Superheating	1,051	1,367
Comb. evaporative and superheating	4,837	4,843

The water space in the boiler below the second gage cock is 683 cu. ft. and the steam space above is 108 cu. ft. or 14 per cent of the total boiler volume.

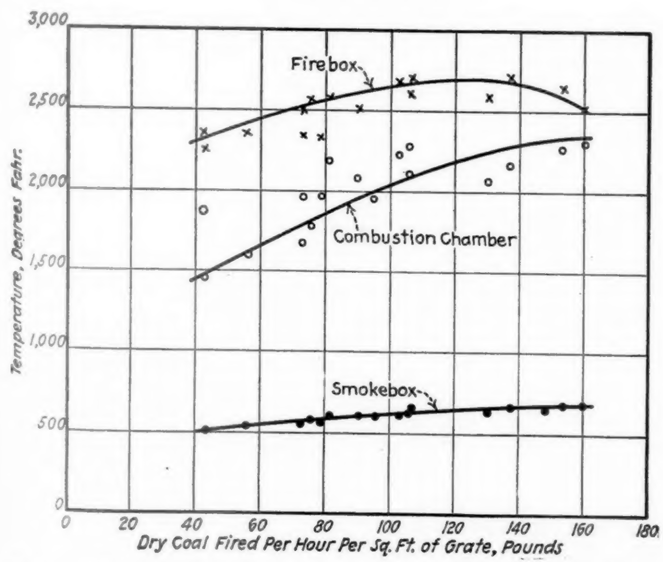


Fig. 2—Gas temperatures in firebox, combustion chamber and smokebox

The total air inlet in the firebox is 28 sq. ft., 26.9 sq. ft. being through the grate and 1.1 sq. ft. above the fire bed. The air openings through the grates constitute 41 per cent of the grate area. The net gas area of the openings through the tubes and flues is 8.5 sq. ft.

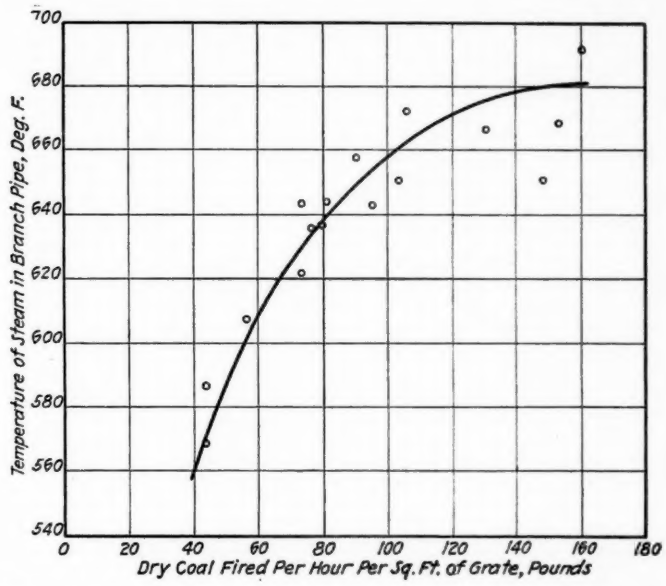


Fig. 3—Temperatures of steam in branch pipe at different rates of combustion

The area of the air inlets to the ashpan is 14.5 sq. ft. or 171 per cent of the area of the tube and flue openings.

The locomotive is equipped with the Baker valve gear

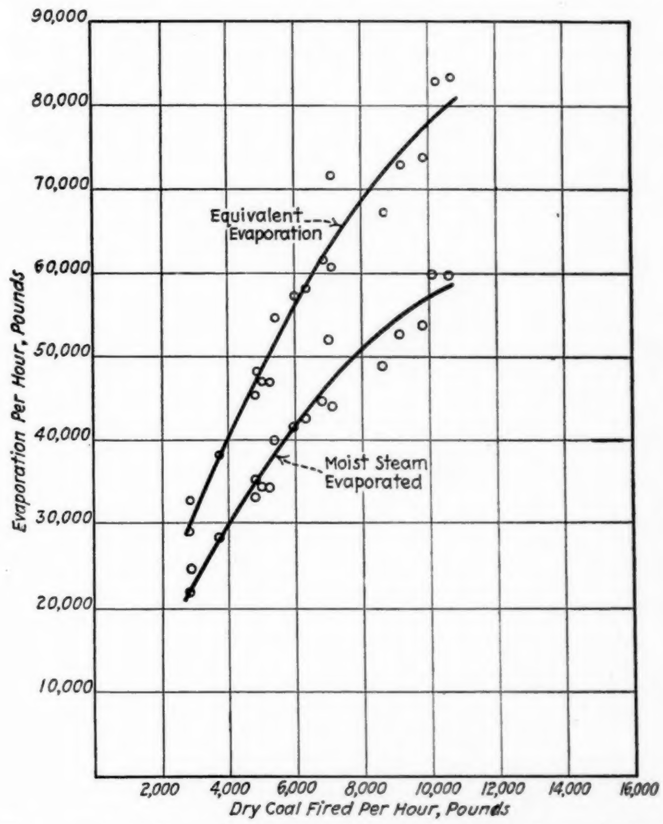


Fig. 4—Actual moist steam evaporated and equivalent evaporation at different rates of firing

and the valve for the inside cylinder is operated by the mechanism employed by the American Locomotive Company for all the three-cylinder locomotives that they have built recently. The piston valves have 6½ in. maxi-

mum travel and are laid out for 1 3/16 in. steam lap and no exhaust lap.

The coal was the same as that generally used at the test plant as a standard for freight locomotive tests and road service. It is a Pennsylvania bituminous coal from the

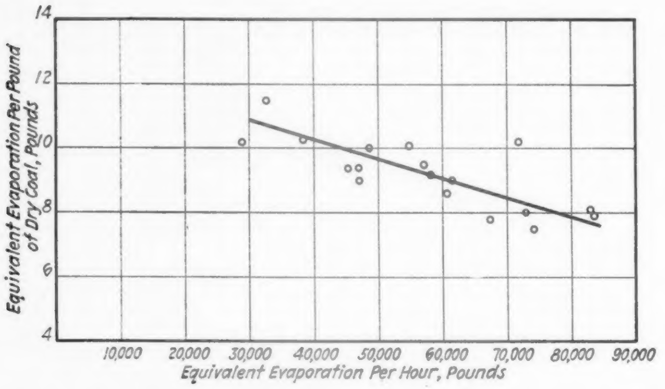


Fig. 5—Variation in equivalent evaporation per pound of dry coal according to boiler output

crows nest mine of the Keystone Coal & Coke Company near Hempfield Station on the main line of the Pennsylvania, in the Greensburg district. It is a Pittsburgh seam coal, medium hard and semi-blocky. The coal contains about 60 per cent carbon and 30 per cent volatile matter and has a calorific value of about 13,300 B.t.u. as fired It was in run of mine size, and, while about 30 per cent of it will not go through a screen having 4-in. round openings, it contains small sizes, so that three per cent of it will go through a screen having 1/16 round openings

When the tests were started, the driving axle bearings

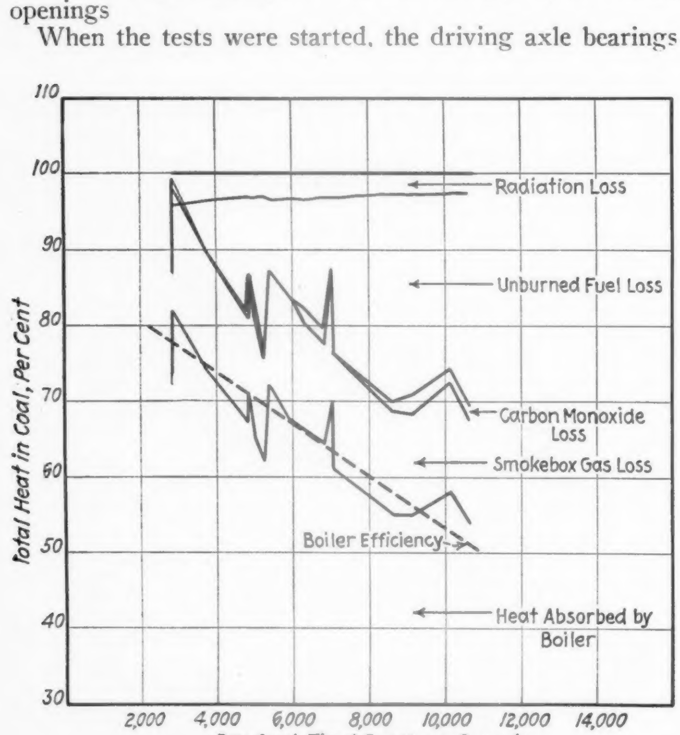


Fig. 6—Boiler efficiency and heat losses

had been run from Schenectady to Altoona but the crank pin bearings had been operated very little. The main crank pin bearings, both outside and inside, are of the floating type in which the brass is in three segments and separated from the rod by a hardened steel liner. The brass bearing is perforated so that the grease has access to both its inner and outer surfaces. On the two outside main crank pins these bearings ran hot until they been well broken in, after which they gave no trouble.

As received at the test plant, the locomotive was difficult to fire and appeared to have insufficient draft. From the similarity to the Pennsylvania Lls. (2-8-2) class it was believed that with proper combustion an evaporation as high as 59,000 lb. of water per hour, or about 12 lb. per square foot of total combined heating surface could be reached. In order to determine this by actual test, a run was made at 160 r.p.m., 50 per cent cut off, and wide

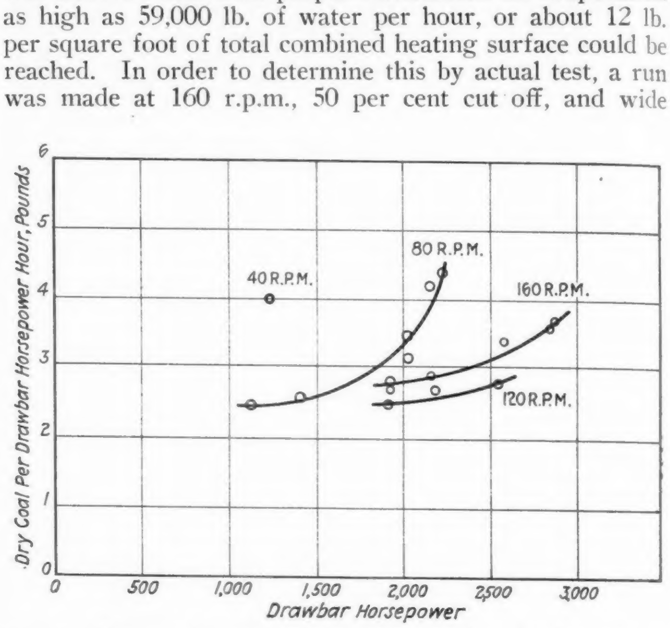


Fig. 7—Dry coal consumption per drawbar horsepower at various speeds and loads

open throttle, as soon as the locomotive had been operated on the plant enough to make such a heavy load feasible. The result was an evaporation of only 48,000 lb. per hour, or about 10 lb. per sq. ft. of total combined heating surface. The draft in the smoke box was 9 in. of water. Measurements of the velocity head of the smokebox gases at the top of the stack showed all positive pressures, and as much as 10 in. or 11 in. of water at the edges.

The stack of the locomotive has a diameter of about

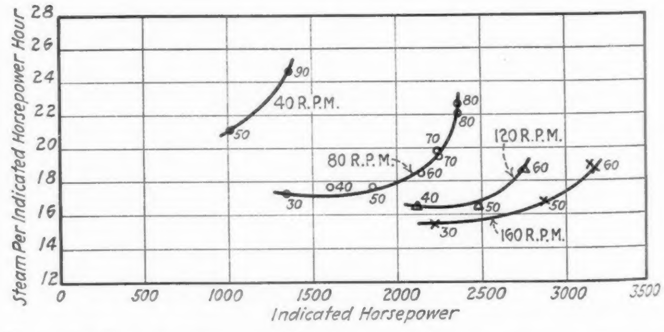


Fig. 8—Steam consumption per indicated horsepower at different speeds and loads—Small figures denote cut-offs

19 in. at the top, tapering to 18 in. near the top of the smokebox, and then tapering out to a much larger diameter at the lower end, which is about 2 ft. 5 in. above the exhaust nozzle.

For the purpose of improving the draft conditions, a basket bridge was fitted to the exhaust nozzle, the inside diameter of the tip was increased to 6½ in. and the stack was fitted with an extension the lower end of which was about 15 in. above the nozzle. Trials with this arrangement showed little improvement in the strength of the draft.

On account of the similarity of the boiler of No. 1699 to that of the Pennsylvania Lls. class, it was thought that the essential features of the Lls. front end, that is, its arrangement of stack and nozzle, might enable No. 1699 to steam properly. The Lls. stack has a diameter of 17 in. at the base and tapers uniformly to the top where the diameter is 24 in., resulting in an area at the top about 50 per cent greater than in the original stack of No. 1699. After this stack, which was found to fit the front end arrangements of this locomotive, had been applied, and with the same 6½-in. exhaust nozzle, with basket bridge,

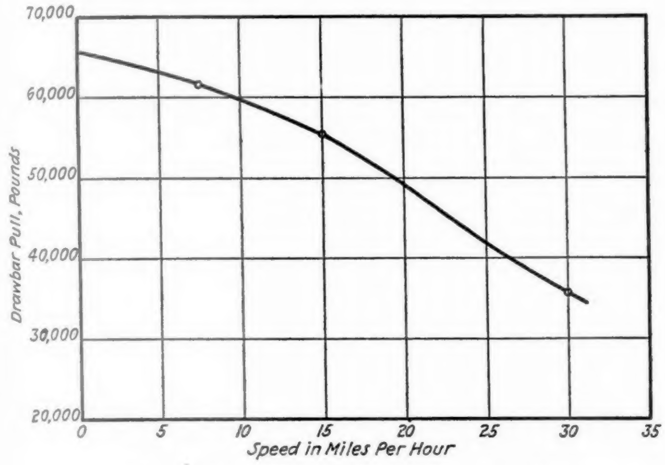


Fig. 9—Drawbar pull at various speeds

a test at 160 r.p.m., 50 per cent cut-off and full throttle showed the limit of the boiler to have been reached at an evaporation of 46,440 lb. per hour. The pressures at the top rim of the stack were small and most of them negative, indicating a vacuum of 4 in. to 7 in. of water, which showed that the stack was not filled. The exhaust nozzle was then increased in diameter to 7 in., retaining the basket bridge, after which an evaporation of 55,000 lb. per hour was obtained.

Notwithstanding the improvements resulting from the changes just described, the firing on heavy load tests was still difficult and the locomotive did not steam freely.

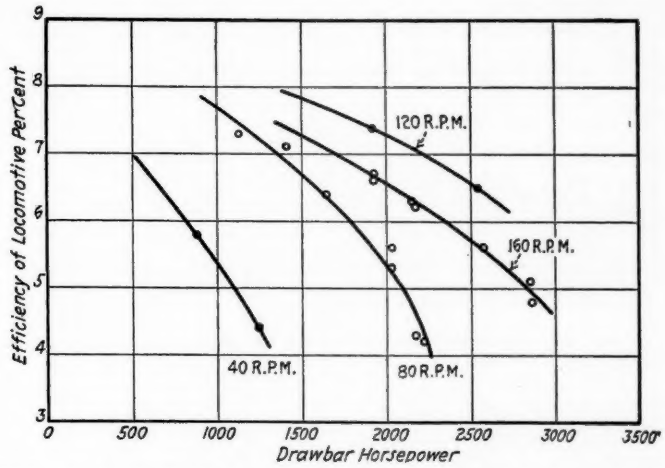


Fig. 10—Overall efficiency of the locomotive at various speeds and loads

Finally, the basket bridge was removed and Goodfellow projections were added to the 7-in. diameter nozzle, and this, with the Lls. stack, was found to make the steaming and draft conditions very satisfactory. It was now found possible to reach an evaporation of 59,900 lb. per hour and later, 61,680 lb. The latter figure corresponds to 12.6 lb. per square foot of heating surface per hour.

Results of tests

A total of 28 runs were made while the locomotive was on the test plant. The duration of the runs was from 15 minutes to two hours, the majority of them being one

Summary of tests on Missouri Pacific three-cylinder Mikado locomotive No. 1699

BOILER PERFORMANCES—EFFICIENCY

Test designation R.P.M. cut-off throttle	Coal as fired per hr., lb.	Dry coal fired per hr., lb.	Coal as fired per hr. per sq. ft. grate, lb.	Dry coal fired per hr. per sq. ft. grate, lb.	Water evaporated per hr., lb.	Equivalent water evaporated per hr., lb.	Water evaporated per lb. of coal as fired, lb.	Equivalent water evaporated per lb. of dry coal fired, lb.	Boiler pressure, lb. per sq. in.	Temperature of feed water, deg. F.	Temp. of steam at boiler pressure, deg. F.	Temperature of superheat, deg. F.	Temperature of superheated steam, deg. F.	Boiler efficiency, per cent
80-30-F	2,897	2,778	43.7	41.9	24,202	32,126	11.1	11.6	196	46	386.4	191.6	578	83
80-30-F	3,104	3,000	46.8	45.2	23,567	31,104	10.0	10.4	194	54	385.6	189.4	575	74
80-30-F	3,000	2,852	45.2	43.0	24,652	32,684	10.9	11.5	198	48	387.2	199.8	587	82
80-40-F	3,798	3,717	57.3	56.1	28,445	38,332	10.1	10.3	197	41	386.8	221.2	608	74
BOILER PERFORMANCES—CAPACITY														
160-50-F	8,821	8,636	133.0	130.3	48,925	67,349	7.6	7.8	198	44	387.2	279.8	667	55
160-60-F	10,429	10,173	157.3	153.4	59,920	82,877	7.9	8.1	199	41	387.6	281.4	669	58
120-60-F	7,285	7,056	109.9	106.4	51,974	71,845	9.9	10.2	198	42	387.2	285.8	673	70
160-60-F	11,340	10,626	171.0	160.3	59,867	83,453	7.4	7.9	198	41	387.2	304.8	692	54
40-90-F	5,275	5,005	79.6	75.5	34,504	46,890	8.9	9.4	198	44	387.2	248.8	636	65
160-60-F	12,589	11,948	189.9	180.2	61,680	84,705	6.7	7.1	197	44	386.8	271.2	658	49

ENGINE PERFORMANCES—EFFICIENCY

Test designation R. P. M., cut-off, throttle	Total indicated horsepower	Coal as fired per i. hp. per hr., lb.	Dry coal fired per i. hp. per hour., lbs.	Steam per i. hp. per hr., lb.	Tractive force based on M.E.F., lb.	Drawbar pull average lb.	Machine efficiency of loco., per cent	Overal efficiency of loco., per cent
80-30-F	1,294	2.2	2.1	18.7	32,291	26,693	83	7.2
80-30-F	1,268	2.4	2.3	18.4	31,642	26,571	84	6.7
80-30-F	1,339	2.1	2.0	17.3	33,414	28,256	85	7.3
80-40-F	1,605	2.3	2.3	17.7	40,052	35,110	88	7.1
ENGINE PERFORMANCES—CAPACITY								
160-50-F	2,868	3.0	3.0	16.8	35,785	32,112	90	5.6
160-60-F	3,141	3.3	3.2	19.0	39,191	35,488	91	5.1
120-60-F	2,752	2.6	2.5	18.7	45,783	42,330	92	6.5
160-60-F	3,176	3.5	3.3	18.7	39,628	35,718	90	4.8
40-90-F	1,364	3.8	3.6	24.7	68,076	61,847	91	4.4
160-60-F	3,117	4.0	3.8	19.6	38,892	35,375	91	4.3

hour long. In all but one short run the locomotive was stoker fired. A full throttle was used in all tests. Speeds were 40, 80, 120 and 160 r.p.m., or approximately 7½, 15, 22½ and 30.1 m.p.r. The first six runs were made with the smokebox arrangement as received and with a 6¼-in. exhaust nozzle tip. Changes were then made in smokestack and exhaust nozzles, after which 11 runs were made

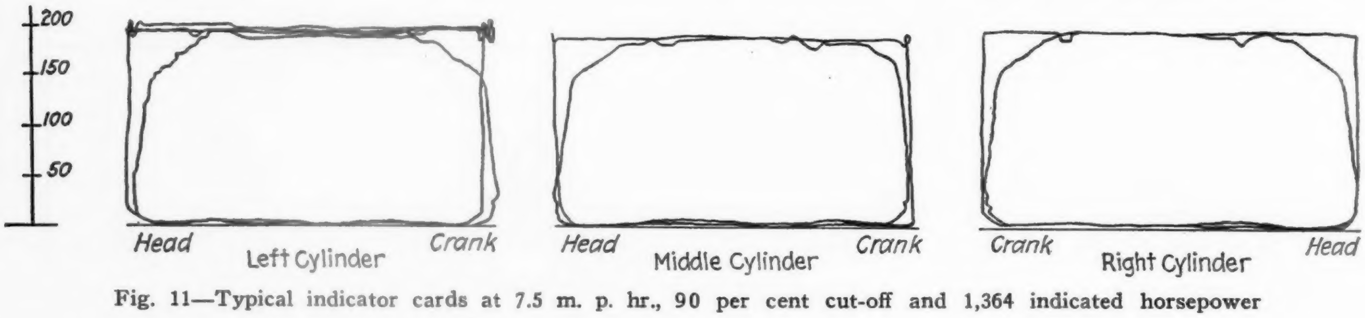


Fig. 11—Typical indicator cards at 7.5 m. p. hr., 90 per cent cut-off and 1,364 indicated horsepower

with the smokestack similar to the Pennsylvania Lls. or 2-8-2 type locomotive and a 7-in. exhaust nozzle with Goodfellow projections. A general summary of the boiler and engine performances as ascertained by typical tests is shown in the accompanying tabulation. In the tables the first group or efficiency tests were with the original smokebox arrangement and the second group or capacity

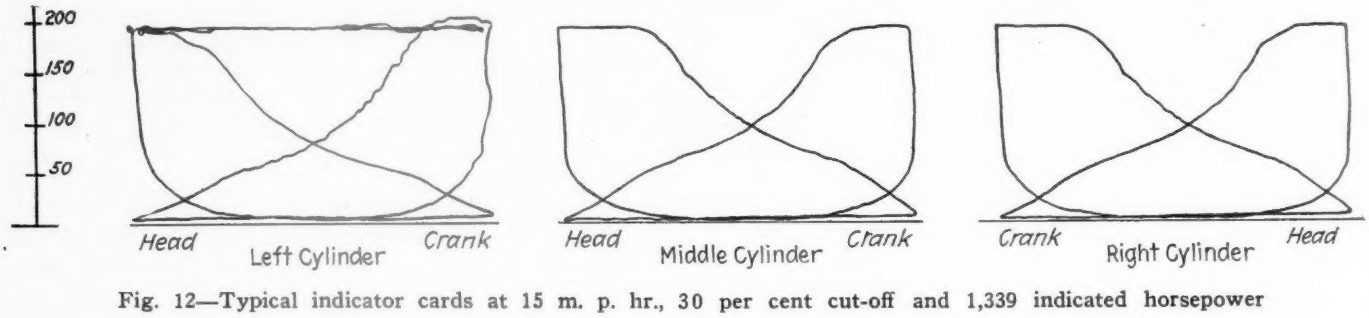


Fig. 12—Typical indicator cards at 15 m. p. hr., 30 per cent cut-off and 1,339 indicated horsepower

tests were made with the modified smokebox arrangement.

The boiler performance was excellent as its evaporation ranges from 6.7 lb. to 11.1 lb. of water per pound of coal as fired, according to the speed and the amount of coal burned per square foot of great area per hour which ranges from 43.7 lb. to 189.9 lb. The boiler pressure was

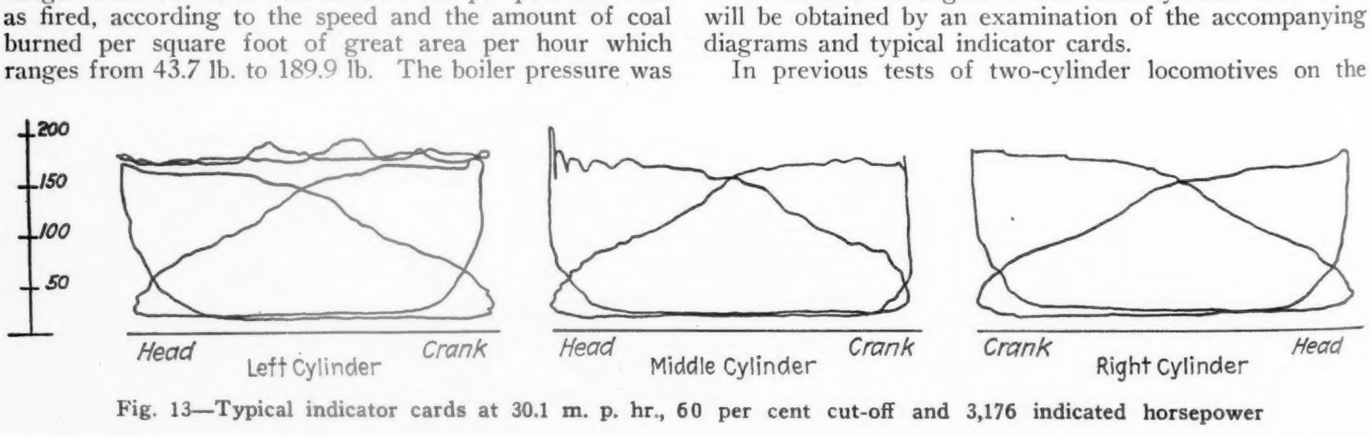


Fig. 13—Typical indicator cards at 30.1 m. p. hr., 60 per cent cut-off and 3,176 indicated horsepower

maintained near its intended pressure of 200 lb. per sq. in. The boiler efficiency at 11.1 lb. of water evaporation per pound of coal was 83 per cent—very good even in stationary service—and was 49 per cent at the time when the boiler was forced to its limit at high speed and at its maximum evaporation of 61,680 lb. or an equivalent evaporation of 84,705 lb. per hour. The superheat in the steam was always near 250 to 280 deg. F, making the total temperature of steam approximately 675 deg. F.—a desirable condition of superheat. All results show the boiler to be well proportioned in firebox, grate area, heating surface and steam space and also in superheating surface.

The engine performance was equally as good. The calculated nominal tractive force is 65,700 lb. and the locomotive developed a drawbar pull of 61,847 lb. at a speed of 7½ miles per hour and 90 per cent cut-off. The maximum power developed was 3,176 hp. which was reached at a speed of 30 miles per hour and 60 per cent cut-off, with an engine efficiency of 90 per cent. The maximum engine efficiency of 94 per cent was reached at a speed of 15 miles per hour and 80 per cent and 90 per cent cut-off, which shows an excellent performance for the locomotive.

Additional information relative to the performance of the boiler and the engine of this three-cylinder locomotive will be obtained by an examination of the accompanying diagrams and typical indicator cards.

In previous tests of two-cylinder locomotives on the testing plant it was found that the fore and aft motion or vibration due to the unbalanced reciprocating parts became so severe at a speed below 200 r.p.m. that additional balance weights were needed in the wheels for test plant operation and it has been customary to add sufficient weights to balance completely all the reciprocating weights. With this three-cylinder locomotive no additional balance weights were applied and a speed of 235

r.p.m. was reached before the fore and aft vibration became violent enough to endanger the mechanism of the dynamometer. It was the conclusion that without special counterbalancing a two-cylinder locomotive could be operated safely at a speed of 180 r.p.m. and a three-cylinder locomotive at a speed of 240 r.p.m., or at approximately one-third greater speed. At all speeds the drawbar pull lines were more even than those obtained from two-cylinder locomotives.

No measurements were taken of the turning moment or torque for comparison with the usual two-cylinder arrangement.

In conclusion it may be said that with the exception of the front end arrangement the efficiencies of both boiler and engine and the boiler capacity were excellent. This will be evident from a comparison of the results of the tests of this locomotive with those of two cylinder locomotives of comparable dimensions.

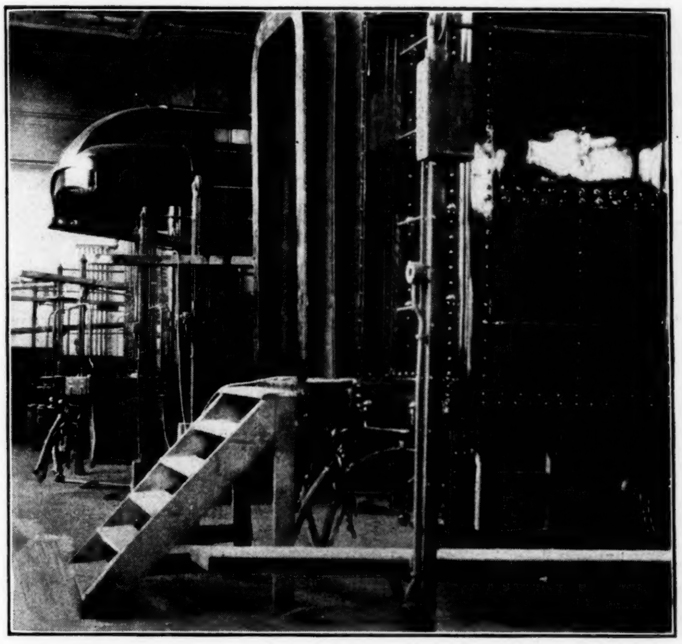
Table of dimensions, weights and proportions

Railroad	Missouri Pacific
Type of locomotive	2-8-2, 3-cylinder.
Service	Freight.
Cylinders, diameter and stroke, outside	23 in. by 32 in.
Cylinders, diameter and stroke, inside	23 in. by 28 in.
Valve gear, type	Baker.
Valves, piston type	—
Maximum travel	6½ in.
Outside lap	1⅜ in.
Exhaust clearance	0
Weights in working order:	
On drivers	244,500 lb.
On front truck	34,500 lb.
On trailing truck	61,000 lb.
Total engine	340,000 lb.
Tender	190,100 lb.
Wheel bases.	
Driving	17 ft. 10 in.
Total engine	37 ft. 5 in.
Total engine and tender	72 ft. 3½ in.
Wheels, diameter outside tires:	
Driving	63 in.
Front truck	33 in.
Trailing truck	43 in.
Boiler:	
Type	Straight top.
Steam pressure	200 lb.
Fuel, kind and B. t. u.	Bitum.—13,300.
Diameter, first ring, inside	88 in.
Firebox, length and width	114⅛ in. by 84¼ in.
Height mud ring to crown sheet, back	68⅝ in.
Height mud ring to crown sheet, front	90½ in.
Arch tubes, number and diameter	2, 3 in.
Thermic syphons	2
Tubes, number and diameter	199, 2¼ in.
Flues, number and diameter	45, 5½ in.
Thickness tubes and flues	.120 in.—.148 in.
Length over tube sheets	19 ft.
Net gas area through tubes and flues	8.5 sq. ft.
Air inlet through grates	26.9 sq. ft.
Air inlet above fire bed	1.1 sq. ft.
Air inlet to ash pan	14.5 sq. ft.
Grate type	Table.
Grate area	66.3 sq. ft.
Heating surfaces:	
Firebox and syphon	335 sq. ft.
Arch tubes	14 sq. ft.
Tubes	2,214 sq. ft.
Flues	1,223 sq. ft.
Total evaporative	3,786 sq. ft.
Superheating	1,051 sq. ft.
Comb. evaporative and superheating	4,837 sq. ft.
Special equipment:	
Brick arch	Yes
Superheater	Type A
Feedwater heater	No
Stoker	Elvin
Tender:	
Water capacity	10,000 gal.
Fuel capacity	16 tons
General data estimated:	
Rated tractive force, 85 per cent	65,700 lb.
Cylinder horsepower (Cole)	2,737
Speed at 1,000 ft. piston speed	35.2 m.p.h.
Steam required per hour	51,900 lb.
Coal required per hour, total	8,800 lb.
Coal rate per sq. ft. grate per hour	134 lb.
Weight proportions, estimated:	
Weight on drivers ÷ total weight engine, per cent	71.9
Weight on drivers ÷ tractive force	3.72
Total weight engine ÷ cylinder hp	124.2 lb.
Total weight engine ÷ comb. heat. surface	70.3 lb.
Boiler proportions, estimated:	
Comb. heat. surface ÷ cylinder hp.	1.76
Tractive force ÷ comb. heat. surface	13.58
Tractive force × dia. drivers ÷ comb. heat. surface	856
Cylinder hp. ÷ grate area	41.3
Firebox heat. surface ÷ grate area	5.26
Cylinder hp. ÷ gas area (tubes and flues)	322
Grate air inlet ÷ grate area, per cent	40.5
Ash pan air inlet ÷ grate area, per cent	21.8
Firebox heat. surface, per cent of evap. heat. surface	9.2
Superheat. surface, per cent of evap. heat. surface	27.8
Tube length ÷ inside diameter	113

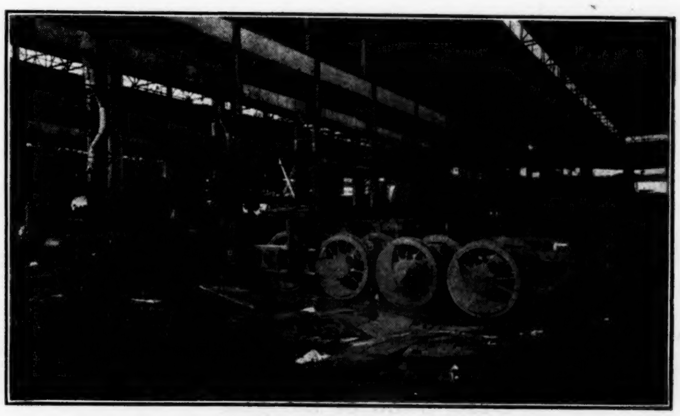
Convenient steps for use in coach repair shops

It is often the case that the most simple arrangement used in a repair shop proves to be a time-saving device of some moment. Such is the case with the flight of wooden steps shown in the illustration which is used in the Kingsland shops of the Delaware, Lackawanna & Western.

It was observed from past experience that it was not unusual to have, in the coach shops, several cars with all the steps removed, or dining cars which have no steps for easy entrance. This condition naturally made it difficult for the workmen to get in and out of these cars and especially difficult to carry in material. As a result, several flights of wooden steps were built just high enough to be level with the vestibule platform of the cars. These steps are placed at the rear of the platform which afford the workmen easy access to the cars. Furthermore, bulky or lengthy materials may be carried into the car without having to make a sharp turn as is the case when using a side entrance.



Steps placed for easy entrance into a dining car

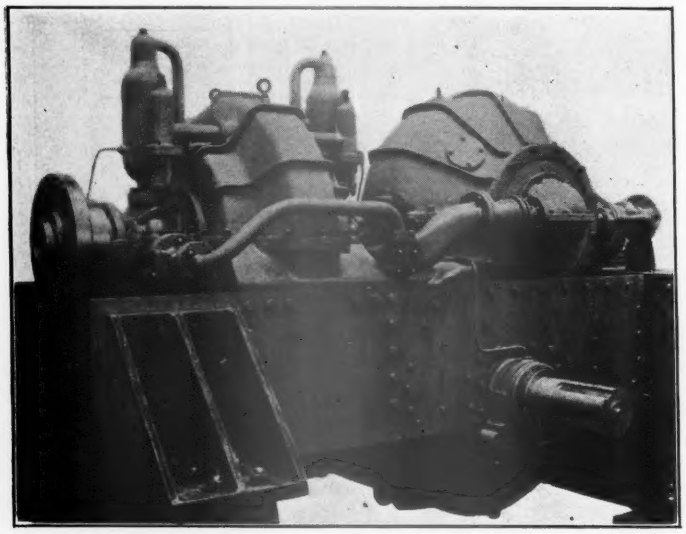


Interior view of the erecting shop at the Eddystone Plant of the Baldwin Locomotive Works, Philadelphia, Pa.

Schneider hydraulic transmission for Diesel locomotives

Combination of mechanical and hydraulic coupling employed—Tests show high efficiency

ALL hydraulic transmissions which up to this time have been developed to the point of application on locomotives or motor cars have operated on what might be termed a full hydraulic coupling principle, the power being transmitted hydraulically and speed regulation obtained by driving and driven pumps in the primary and secondary elements. The applied power is absorbed by the primary element, converted into hydraulic pressure and velocity and then reconverted into mechanical energy in the secondary pump, which acts as a motor, thus transmitting the power to the driven shaft, the speed of which is regulated by varying the delivery volume and pressure of the oil.



Schneider hydraulic transmission completely assembled—This is a 500-hp. equipment

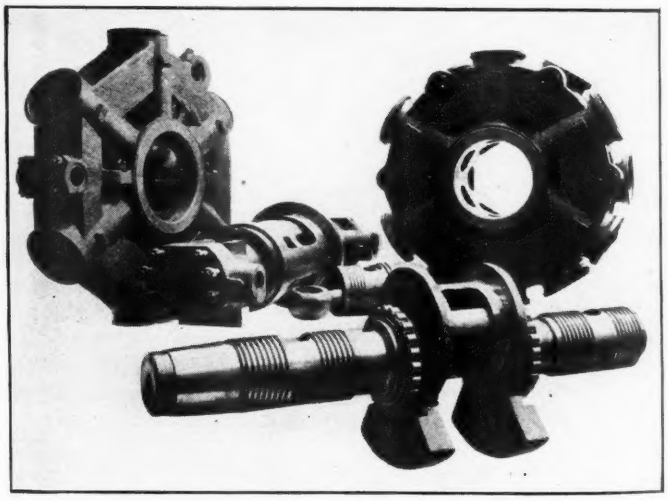
The Swiss Locomotive & Machine Works, Winterthur, Switzerland, is manufacturing a hydraulic transmission which differs materially in principle and construction from the usual type. The patent rights on this development are controlled by Heinrich Schneider, Winterthur, Switzerland, and G. A. Schneider, Montreal, Quebec.

The primary and secondary elements of the Schneider gear, in addition to being hydraulically coupled, are both coupled mechanically to the jack shaft from which the power is transmitted to the driving wheels. With this arrangement a varying portion of the power is transmitted directly to the jack shaft, the rest being hydraulically transmitted through the driving and driven pumps. That portion of the power which is transmitted hydraulically can be regulated from zero to maximum, according to the ratio of transmission, so that at one predetermined speed, hydraulic conversion is entirely eliminated, together with any consequent hydraulic efficiency losses.

Description of the gear

The first gear of this type was produced for use in a 500-hp. Diesel locomotive. The gear, as a whole, is made up of a primary and secondary element, both of which are mechanically coupled through gearing to a jack shaft which drives, through cranks and connecting rods, the driving wheels of the locomotive.

The primary element consists essentially of a hollow crank shaft directly coupled to the Diesel engine crank shaft, a rotor mounted on the shaft and a stationary housing which is attached to the locomotive frames. The crank shaft is a hollow heat-treated steel casting. The offset of the eccentric portion is 2⅜ in. The shaft is designed with a diagonal bridge wall which separates the intake oil end from the discharge end, providing a passage into one end of the hollow shaft, thence through ports on one side of the eccentric portion of the shaft into the rotor cylinders and, on the other side through an opposite set of ports, from the cylinders into the other end of the shaft. The ends of the shaft revolve in labyrinth packings mounted in the gear casing. Above the labyrinth stuffing boxes air domes and relief valves are provided in order to take up shocks and to allow the oil to escape



From left to right—the primary cylinder block, the secondary axle, one of the pistons, the primary shaft and the secondary cylinder block

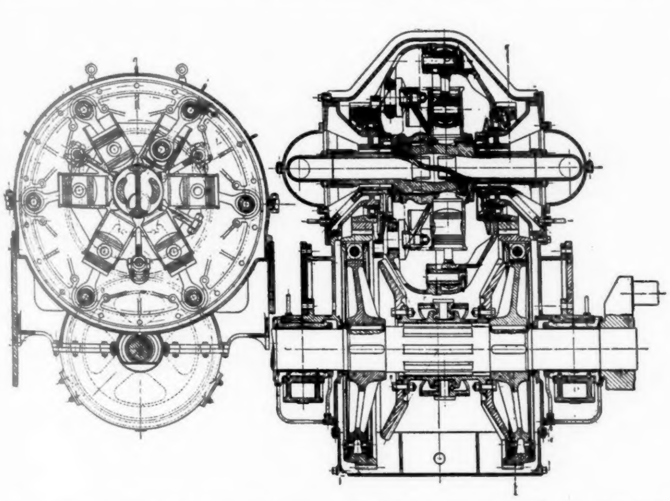
to the outer casing should the pressure exceed a predetermined limit.

The rotor is made up of three elements: the casing, a cylinder block and the pistons which operate in the cylinders. The rotor casing revolves on roller bearings about the axis of the shaft and is also mounted in roller bearings carried in the main casing of the primary element. Mounted on the outside of the rotor casing at each end is a spiral gear ring. These mesh with two corresponding spiral gears keyed to an intermediate shaft, upon which is carried a spiral bevel gear that drives on the jack shaft. Inside of the rotor casing is a cylinder block mounted on the eccentric portion of the primary crank shaft which revolves in the cylinder block on soft metal liquid-tight bearings. The cylinder block contains six cylinders and

is cast in two halves with the cylinders arranged radially in one plane. These cylinders are open at their outer ends to receive the pistons which are secured to the rotor casing by means of connecting rods. The cylinder block in operation moves about within the rotor casing in a circular orbit, the radius of which is equal to the throw of the eccentric portion of the primary crank shaft. To prevent the cylinder block from changing its angular position with respect to the rotor casing, it is secured to the casing by three links which are free to revolve about their bearings in the casing. The length of these links is equal to the throw of the primary crank shaft.

The primary element transmits the mechanical portion of the power input to the jack shaft by means of the bevel gears. Two driven bevel gears are placed on opposite sides of the driving gear. They are mounted on a spline tube which may be moved laterally on the jack shaft in order to throw either one or the other into mesh with the driving gear, thus producing the forward or reverse motion of the jack shaft.

The secondary element is composed essentially of three parts: the shaft, the rotor and the stationary outer casing. The shaft of the secondary element is not a shaft in the true sense of the word, but is, in effect, a stationary hollow axle about which the rotor revolves. Provision is made for its horizontal displacement from the center about which the rotor revolves, on guides attached to the outer stationary casing. This imparts an eccentric motion of variable throw to the cylinder block. To either end of this axle is attached an elbow which is mounted within a telescoping stuffing box. To these boxes the oil pipes are connected. In a similar manner to that of the primary crank shaft, a diagonal bridge wall divides the two ends of this axle into two separate chambers which open through ports at the center to the cylinders of the rotor element. The rotor of the secondary element consists of

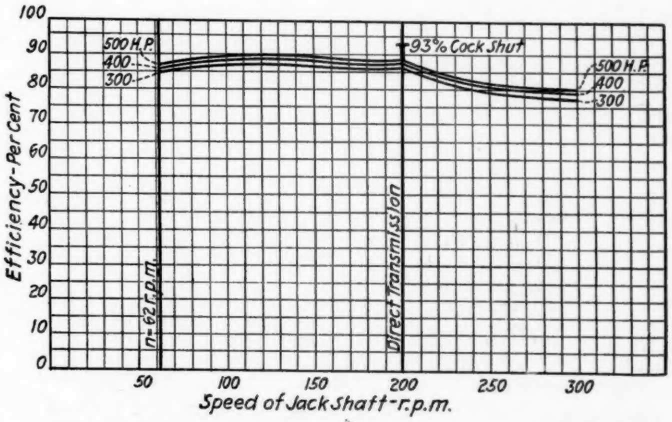


Sections through the primary (left) and secondary (right) elements taken parallel to the axis of the jack shaft

the same essential parts as that of the primary element. At either end of the rotor casing are mounted spiral gear rings which mesh with spiral gears keyed to the jack shaft. The cylinder block contains 12 cylinders arranged in two rows of six cylinders each in parallel planes. The outer ends of these cylinders are open to receive the pistons which are connected to the rotor casing by means of connecting rods. The link connections between the cylinder block and rotary casing of the primary element are replaced in the secondary element by six pin connections on the cylinder block, each of which rotates in a revolving block mounted in the motor casing. The pin bears in a slot extending across the diameter of the revolving block in which it is free to adjust its throw in conformity with the eccentricity of the axle with respect to the center of rotation of the rotor casing.

Method of operation

When the locomotive is at rest, the rotor of the primary element is held stationary by the gearing through which it is mechanically coupled to the jack shaft. The primary crank shaft, however, revolves with the Diesel engine crank shaft to which it is coupled. When the primary crank shaft rotates, it carries the cylinder block with it around its orbit within the rotor casing and the resultant movement of the cylinders over the pistons produces a



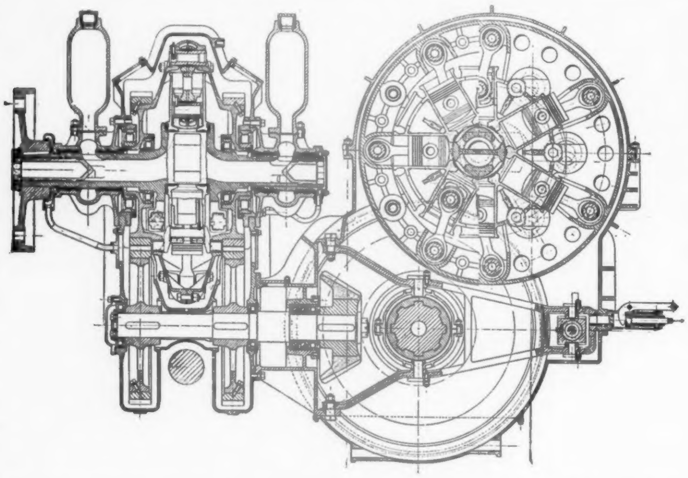
Curves showing the result of efficiency tests of the Schneider hydraulic transmission for constant engine power outputs

suction in three adjacent cylinders and pressure in the opposite three cylinders, thus causing circulation of the oil. The ports in the crank automatically control the admission and discharge of the oil to and from the cylinders.

Control valves are located in the piping connecting the primary and secondary elements and in a primary by-pass connection. In starting the Diesel engine without load and when the locomotive is standing with the prime mover in motion, the by-pass connection is open so that the oil freely circulates from the delivery side directly to the intake side of the primary element and no power is absorbed by the gear. To start the locomotive, hydraulic communication is established between the primary and secondary elements of the gear and the by-pass valve gradually closed, thus effecting a gradual loading of the engine and pick-up in the speed of the locomotive itself.

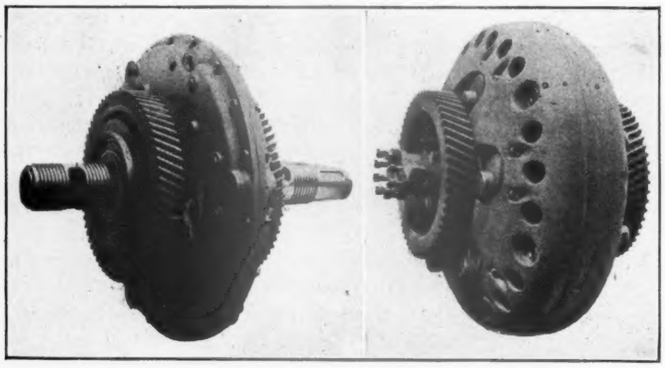
As the by-pass is gradually closed and hydraulic transmission built up, the reaction of the oil pressure tends to cause the primary rotor to rotate in the same direction as the crank shaft, this producing a reaction through the gears tending to rotate the jack shaft. At the same time the hydraulic pressure through the secondary element tends to cause the rotor of this element to revolve and this, through the gear connection, also reacts on the jack shaft. As the jack shaft gradually increases in speed with the engine running at constant speed, the revolutions of the primary rotor also increase in the same direction that the crank shaft is revolving, thus reducing the effective number of revolutions per minute of the crank shaft with respect to the rotor and correspondingly reducing the displacement of oil until a balance is reached when the volume of oil displaced by the primary element is equal to that displaced by the secondary element, the by-pass valve then being completely closed. This speed in the 500-hp. locomotive is 72.5 r.p.m. with the engine developing its full horsepower at 400 r.p.m. of the crank shaft.

To further increase the speed, the eccentricity of the secondary axle must be reduced, thus reducing the volume of oil displacement per revolution of the secondary rotor. Since the eccentricity of the primary crank shaft is fixed, a corresponding reduction in oil displacement is brought about through a further decrease in the relative speed of the crank shaft with respect to the primary rotor which results from an increase in the actual speed of the rotor and a corresponding increase in the speed of the locomo-



Section through the transmission taken at right angles to the jack shaft axis—The primary element is at the left and the secondary at the right

tive. The speed of the locomotive may be increased through this process until the eccentricity of the secondary shaft has been reduced to zero and the displacement of oil also reduced to a zero condition which requires that no further movement of the pistons in the primary element take place. The oil thus becomes, in effect, a solid body which locks the rotor of the primary element to the primary crank shaft, causing the former to revolve with the latter. Under this condition, the entire power of the



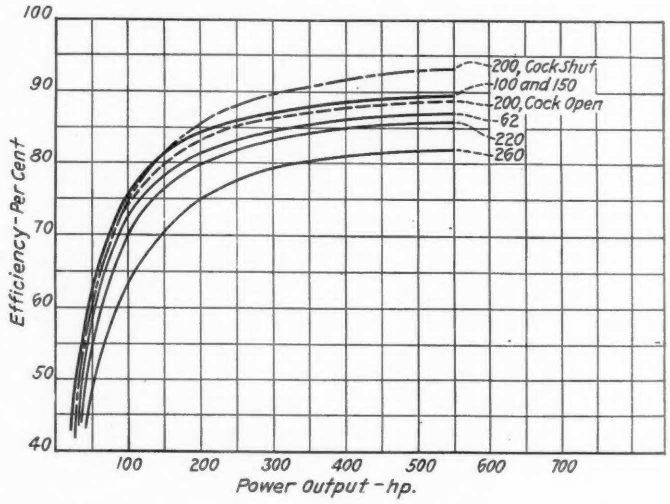
Primary (left) and secondary (right) elements of the Schneider hydraulic transmission

engine is transmitted mechanically from the primary element to the jack shaft, the secondary revolving idly. For the locomotive in question, this condition is reached at a speed of 230 r.p.m. of the crank shaft with full speed of the prime mover.

By referring to the diagram showing the efficiency characteristic of the transmission, it will be seen that for the 500-hp. locomotive the efficiency varies but slightly during the range of speed from starting up to the direct mechanical drive, and that it is slightly under 90 per cent. By closing the valve in the hydraulic connection from the primary to the secondary, thus relieving the secondary of pressure, the efficiency at this speed is increased to 93 per cent. The tests in which the efficiency of the transmission was measured were made with an electric motor driving the primary crank shaft at a maximum speed of 350 r.p.m., which accounts for the low-gear speed of the jack shaft of 62 r.p.m. and a direct drive speed of 200 r.p.m., instead of 72.5 r.p.m. and 230 r.p.m., respectively, for the full engine speed of 400 r.p.m.

By continuing the movement of the secondary axle beyond the neutral point to a negative eccentricity, further increase in speed of the locomotive may be effected. In this case the secondary element becomes the driving pump, taking the power from the jack shaft and transmitting it to the primary element which is caused to rotate in the same direction as its crank shaft, but at a greater speed than the crank shaft.

What takes place fundamentally through the range of operation of the transmission is evident from the torque characteristics of the two elements. The eccentricity of the primary crank shaft being fixed, the oil pressure in the hydraulic system remains constant under all operating conditions, except for sudden changes which may cause momentary increases, which are cushioned by means of



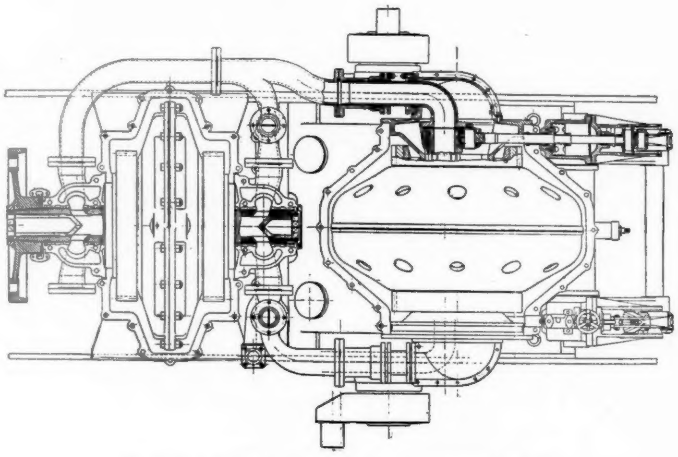
Efficiencies of the transmission for varying power outputs and jack shaft speeds

the air chambers. The constant oil pressure produces a constant torque in the primary rotor equal to the torque of the engine shaft. This torque is always acting on the jack shaft through the primary gear connections. The variation in the jack shaft torque required for the absorption of the full engine horsepower at varying speeds is effected by the secondary element, which delivers a positive torque varying from its maximum at the low speed, to zero at the direct drive and thence becomes negative in varying amount as the speed is increased above that of the direct drive.

The transmission may be reversed in two ways. If the eccentricity of the secondary axles is moved to its full amount on the negative side while the locomotive is standing, on beginning to close the by-pass valve the torque produced by the oil acting on the secondary pistons, is reversed, tending to revolve the jack shaft backwards. This movement, however, starts the primary rotor to revolve backwards on the primary crank shaft, thus increasing the speed of the rotor with respect to the crank shaft, increasing the rate of oil displacement and increasing the power output of the prime mover. This excess of power, of course, reappears at the secondary through the increased hydraulic performance and is in turn taken off the jack shaft through the forward reaction of the

primary gears working against the backward motion of the shaft. Under this condition the lowest speed at which a balance is reached (with the by-pass fully closed) is 195 r.p.m., a speed which reduces the tractive force to about one-third of the maximum at the forward motion low speed.

The other method of reversing the locomotive is to reverse the primary bevel gear drive as well as the eccen-



Plan view of the 500-hp. transmission

tricity of the secondary axle. Under these conditions the operating characteristics are exactly the same as for forward motion.

The eccentricity of the secondary axle is controlled by means of two servo motors arranged in parallel, the operation of which is controlled by a single crank handle in the driver's cab. There are two hand wheels for effecting the hydraulic control. One operates the by-pass cock and another operates the valve by means of which the secondary gear is isolated and relieved of pressure in the case of direct mechanical transmission. The graduation of the stroke of the secondary pistons, the operation of the hydraulic cocks, the reversing of the primary gears and the control of the prime mover are all interlocked with each other so that no false maneuvering is possible.

Description of the Diesel locomotive

At this writing a four-cylinder, two-cycle, 500-b.hp. Diesel engine and the hydraulic gear described above, have been under test for some months at the plant of the Swiss Locomotive & Machine Works, Winterthur, Switzerland. The oil engine and gear have both been designed and tests conducted under the supervision of Heinrich Schneider, chief engineer of the company.

The oil engine employs a solid fuel injection system which does not involve the use of high pressure injection air. Both the oil engine and the gear are to be placed on a trial locomotive for the purpose of making experimental road tests. Some of the more prominent features of this two-cycle solid fuel injection engine consist of a special design of combustion chamber and of the arrangement of ports for the admission of scavenging air and allied control apparatus which allows the engine to be operated at high speed and at high efficiency. As previously described, the Diesel engine will be arranged lengthwise of the locomotive frames, the crank shaft of the engine being connected to the shaft of the primary element in the hydraulic gear by means of a flexible coupling on the engine flywheel. The mechanical transmission system from the engine to the gear is arranged in such a manner that the prime mover revolves in but one direction, all reversing being done within the hydraulic gear. The normal running speed of the engine is 400 r.p.m. and that of the floating shaft in the gear, 230 r.p.m. The estimated weight of the locomotive in working order is approximately 120,000 lb.

Designs have also been made for trial locomotives of 2,000 b.hp.

Report of air brake convention

Association is developing higher standards of maintenance and greater precision in testing

A BRIEF account of the early proceedings of the opening session of the thirty-second annual convention of the Air Brake Association, which was held at the Hotel Alexandria, Los Angeles, Cal., May 26-29, appeared on page 371 of the June issue. Later during the convention the following officers were elected for the year 1925-26: President, R. C. Burns, Pennsylvania; first vice-president, M. S. Belk, Southern; second vice-president, H. A. Clark, Soo Lines; third vice-president, H. L. Sandhas, C. R. R. of N. J.; treasurer, Otto Best, Nathan Manufacturing Company. F. M. Nellis was elected life secretary last year. The executive committee, including the new members, stands: W. W. White, M. C.; William Clegg, C. N.; R. M. Long, P. & L. E.; W. F. Peck, B. & O.; and C. H. Rawlings, D. & R. G. W.

The association voted to hold its 1926 convention at New Orleans, La.

In the following pages will be found abstracts or summaries of the papers, reports and discussions, most of which have an important bearing on the maintenance of air brake equipment.

Report on brake pipe leakage

The committee on brake pipe leakage submitted a progress report in which it summarized the purposes of the committee's investigations as follows: (1) To secure representative data on brake pipe leakage (as distinct from the brake system leakage) as it exists in current train service; (2) to secure data that will show the relation between air leakage from the brake pipe proper and the total leakage from the brake system; (3) to devise means for measuring and recording the total leakage of trains while being operated in regular service; (4) to secure data which will show the ratio of compressed air used for braking purposes and wasted in maintaining leaks; (5) to analyze the data with respect to the effect of leakage on brake operation; (6) to determine what degree of leakage in the brake system can be tolerated without serious interference in the brake action or operation; (7) to analyze the data with respect to cost of the compressed air wasted by leakage; (8) to analyze and compare current methods of inspecting and testing

for brake pipe leaks as well as for methods of repairs and maintenance.

The most important work undertaken by the committee was the development of a means for measuring continuously and recording automatically the total amount of air supplied while operating trains in regular service.

No. of Test	Brake Pipe Pressure Lbs. Front	Brake Pipe Pressure Lbs. Rear	No. of Cars	No. of 8" Equipments	No. of 10" Equipments	Pressure at Orifice Lbs. +	Pressure at Orifice Lbs. –	Average Cu. Ft. Free Air Supplied per minute	A.R.A. Leakage Test Lbs. per minute	Average Cu. Ft. Free Air Computated from A.R.A. Test	Average Cu. Ft. Free Air Supplied per minute per Car	Average Cu. ft. Free Air per Car Computated from A.R.A. Test	% Brake System to Brake Pipe Leakage
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	70	68	24		24	68	63	38.6	8	9.2	1.6	0.38	313
2	70	68	28		28	68	62	42.5	9	12.6	1.5	0.45	237
3	70	67	43		43	65	58	47.1	6	12.5	1.1	0.28	276
4	70	62	93	12	81	65	58	47.1	10	46.6	0.6	0.50	1.7
5	70	68	23	7	16	67	62	38.6	6	6.7	1.7	0.29	479
6	70	62	53	2	51	65	60	39.2	5	12.8	0.8	0.24	206
7	70	68	30	16	14	66	60	43.1	8	11.9	1.4	0.40	262
8	70	68	28		28	67	63	34.5	6	8.3	1.2	0.29	316
9	70	68	21	7	14	68	64	34.3	7	7.2	1.6	0.34	377
10	70	67	52	10	42	66	61	39.1	7	18.0	0.7	0.35	120
11	70	68	24	4	20	68	64	34.4	6	7.0	1.4	0.32	390
12	70	64	82	10	72	66	59	47.0	8	32.2	0.5	0.39	46
	Totals		501	68	433			485.7		188.0			

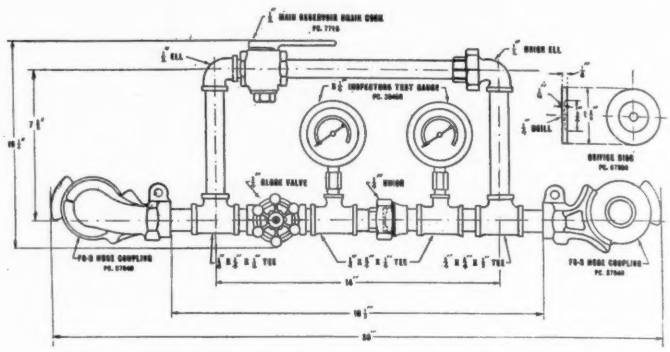
Average cubic feet of free air per car per minute (Brake system leakage) .97
Average cubic feet of free air per car per minute (Brake pipe leakage) .37
Percent increase of brake system over brake pipe leakage 162%

Data which determined the percentage of the brake system to the brake pipe leakage

The report showed in detail the apparatus used for this purpose as well as that employed while making a large number of tests under actual service conditions with train tonnages up to 4,475. The measuring and recording devices were installed in a test car which was piped so that it could be placed in the train directly behind the locomotive tender.

The total number of cars handled during these tests were 2,768, of which 1,119 cars had 8-in. brake equipments and 1,649 cars had 10-in. equipments, the percentages being 40.5 per cent and 59.5 per cent, respectively. The total number of car-hours covered by these tests was 6,772.3 and 357,195 cu. ft. of free air was used to charge the test trains. Of this amount, 189,563 cu. ft. was consumed in brake pipe leakage. The percentage of brake system leakage in terms of brake pipe leakage was 88.5 per cent, or in other words, the leakage from the volume on the auxiliary reservoir side of the triple valve pistons was 88.5 per cent of the leakage from the brake pipe volume. Assuming that the legitimate use of the brake requires one full service application per car-hour of operation, only 3 per cent of the total amount of air is required to overcome leakage in the average brake system.

If the locomotive is equipped with the most modern type of air compressor, the amount of steam required to compress the air used per car-hour of operation would be 12.8 lb. For example, a 100-car train operating for 10 hr. would represent on the above basis, a total of 1,000 car-hours and the locomotive would be required to evaporate 12,800 lb. of water in order to supply the compressed air needed, making a total of 1,532 gal. of water. If it is assumed that the efficiency of the locomotive boiler



Brake system leakage testing device

will permit the evaporation of 7 lb. of water, to a pound of coal, 1,000 car-hours will require the burning of 1,830 lb. of coal on the locomotive in order to supply the necessary steam to the air compressor.

Figures compiled from the statistics of a railroad which owns between 900 and 1,000 locomotives show that the total operating freight car-hours during the year 1924 was 89,587,922 for a total of 10,930,392 cars handled. The cost of the compressed air used for the year on the basis of the average rate of air used found in these tests would be $409,864. Taking this on the basis that 97 per cent of the air supplied is wasted, the year's expense chargeable to brake system leakage would be $397,568.

The total number of leaks found on 2,424 cars tested was 10,634. These figures were the result of a questionnaire sent out to members of the association located in Canada and the United States. The total possible leaks on this number of cars that could be reported is 65,448, so that in these tests, leaks were found at 16.33 per cent of all the places tested, a ratio of one leak in every six possibilities. Of the 2,424 cars, 632 had 8-in. brake equipments and 1,792 cars had 10-in. brake equipments. The percentages being 26 per cent and 74 per cent, respectively. Of all the leaks found, 42.5 per cent were of such a nature as to be considered serious.

According to the committee, the most important fact brought out by the running tests was the exceedingly high

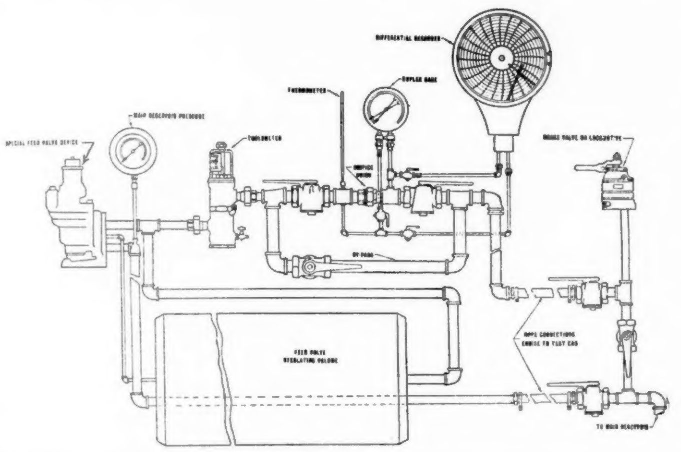
C. M. Kidd (Virginian) president

R. C. Burns (Penna.) first vice-president

M. S. Belk (Southern) second vice-president

H. A. Clark (Soo lines) third vice-president

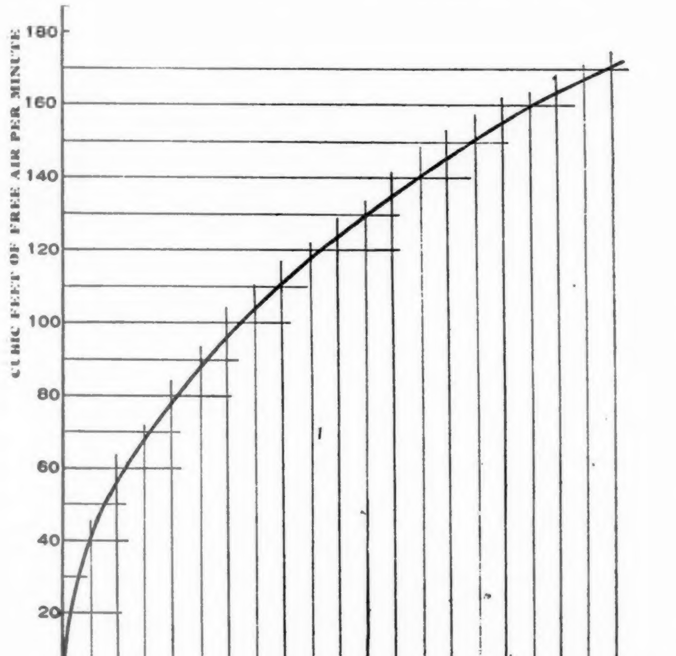
average rate of brake system leakage. The test showed that for the total of 6,772 car-hours of operation, the brake system leakage averaged about 53 cu. ft. per hour for each car or nearly 1 cu. ft. per minute per car. This leakage was made up of brake pipe leakage and auxiliary reservoir volume leakage, the latter being approximately 88 per cent of the brake pipe leakage. If it can be assumed that the running test data secured was representative, the amount of air actually required for brake operations was less than three per cent of the total amount which the compressor supplied to the train.



Measuring and recording apparatus used during running tests

The committee in closing its report, arrived at a number of conclusions, some of which are as follows:

That it is important that regular train inspection should include tests for brake system leakage as well as brake pipe leakage.



Running test—Curve showing relation between difference of pressures on two sides of 27/64 in. orifice and amount of free air used at 60 deg. F.

That a considerable portion of the brake system leaks can be found in the threaded joints of the pipe fittings and air brake equipment devices.

That the tests showed at least 97 per cent of all compressed air used in train operation is wasted by brake system leakage.

That the cost of air wasted and the reduced air brake efficiency due to brake leakage will amply justify a more extensive maintenance program.

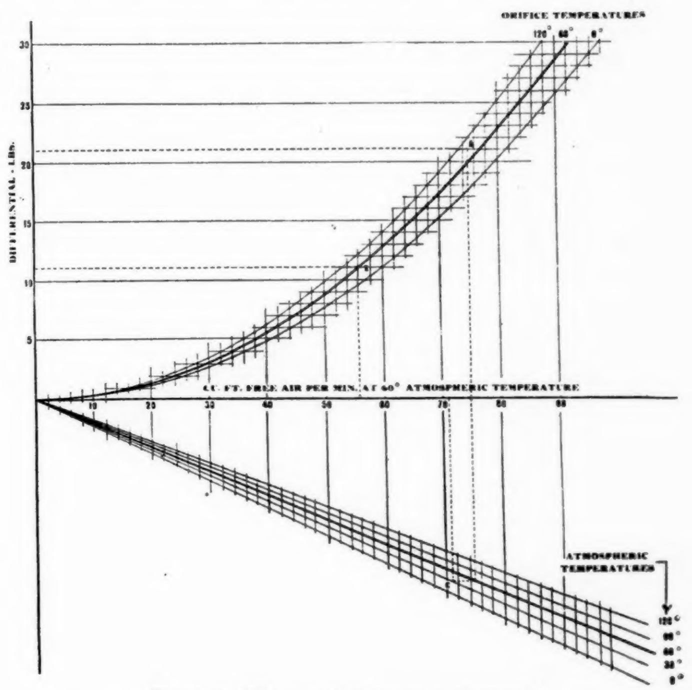
That poor brake equipment installation designs are frequently responsible for difficult brake equipment maintenance.

The committee also recommended that special attention be directed toward brake installation design of existing cars and new cars with a view to making improvements which will make leakage maintenance easier, such as better clamping, elimination of unnecessary pipe joints, reinforcement of pipe threads, etc.

The committee report was signed by C. H. Weaver (New York Central), C. B. Miles (C. C. C. & St. L.), W. W. White (Michigan Central), and R. E. Miller (Westinghouse Air Brake Company).

Discussion

The importance of differentiating between brake pipe and brake cylinder leakage was emphasized, and the necessity of eliminating as far as possible all leaks in the brake system, wherever found. Members of the association corroborated statements contained in the report regarding the wide prevalence of brake system leakage and the resultant heavy expense to the railroads in the way of increased fuel and compressor maintenance costs.



EXAMPLE (WITH TEMPERATURE CORRECTIONS)

Assume 21 lb. differential with orifice temperature 90 deg. F. and atmosphere temperature 30 deg. F.

Start at 21 lb. differential on the vertical scale and pass horizontally to intersect imaginary 90 deg. orifice line at "A." From "A" pass vertically downward to 60 deg. atmospheric line at "B." From "B" pass horizontally to 30 deg. atmospheric line at "C." From "C" pass vertically upward to answer on horizontal scale which is 71.0 cu. ft. of free air per minute.

EXAMPLE (WITHOUT TEMPERATURE CORRECTIONS)

Assume 11 lb. differential when orifice and atmospheric temperatures are 60 deg. F.

Start at 11 lb. differential on the vertical scale and pass horizontally to intersect 60 deg. orifice line at "X." From "X" pass vertically downward to answer on horizontal scale which is 55.5 cu. ft. free air per minute.

Calibration curves for brake system leakage testing device (1/4-in. orifice, 70 lb. gage pressure on train side)

One member suggested that couplings be used when possible in place of unions to eliminate an extra joint and another called attention to the angle cock keys as a prolific source of leaks. He stated that many new cocks received from the manufacturers fail to pass the tests, although this is not always due to defective workmanship.

Of 200 such defective cocks, seven were caused by mishandling in shipment and the others passed the test successfully on being heated and the key turned a few times.

Mr. Miles stated in reply to a question, that the committee is not in a position at the present time to recommend definite leakage limits, but believes that the figure will be about 35 cu. ft. per minute.

The members were urgently requested to make the leakage testing device described in the report and after conducting tests on each road, submit as much information as possible on actual conditions. With this representative information at hand, the committee will be in a position to make definite recommendations in its report next year. The committee was continued.

More efficient air compressors

The possibilities of economy through better air compressor maintenance methods were pointed out in this report, which laid particular stress on the advantages of grinding as compared to boring both air and steam cylinders. The grinding of all cylinders at one setting without removing them from the center castings has been made possible by means of a machine now on the market, thereby obtaining the three advantages of smooth, accurate cylinders, reduced labor cost and accurate alinement of the cylinders, the latter a highly important factor in compressor efficiency and prevention of packing troubles. Comparative cost tables included in the report showed a cost of $374.50 for the boring operations on 100 9½-in. compressors as compared to $100 when the cylinders are ground.

The detailed costs of cylinder work on these 9½-in. compressors as well as on 100 11-in. compressors and 600 8½-in. cross compound compressors were as follows:

Cylinder work on 100 9½-in. compressors

Boring operation—			
2 cylinders removed	at	$.525	$52.50
2 cylinders replaced	at	.46	46.00
2 cylinders bored	at	.76	76.00
2 new gaskets at $.65	at	1.30	130.00
10 new cap screws at $.07	at	.70	70.00
		$3.745	$374.50
Grinding operation—			
2 cylinders ground	at	$1.00	$100.00
Saving			$274.50

Cylinder work on 100 11-in. compressors

Boring operation—			
2 cylinders removed	at	$1.34	$134.00
2 cylinders replaced	at	.73	73.00
2 cylinders bored	at	.96	96.00
2 new gaskets at $1.00	at	2.00	200.00
6 new bolts at $.11	at	.66	66.00
		$5.69	$569.00
Grinding operation—			
2 cylinders ground	at	$1.46	$146.00
Saving			$423.00

Cylinder work on 600 8½-in. c.c. compressors

Boring operation—			
2 pair cylinders removed	at	$.91	$546.00
2 pair cylinders replaced	at	.73	438.00
2 pair cylinders bored	at	2.00	1,200.00
2 new gaskets at $2.09	at	4.18	2,508.00
6 new bolts at $.07	at	.42	252.00
		$8.24	$4,944.00
Grinding operation—			
2 pair cylinders ground	at	$2.92	$1,752.00
Saving			$3,192.00

Saving in grinding over boring for one year

9½ in.	$274.50
11 in.	423.00
8½ in.	3,192.00
Total	$3,889.50

The total of this tabulation shows a saving effected for the year of $3,889.50, which represents six per cent interest on an investment of $64,825, or on the performance of the job alone, at the cost of $5,250 for the machine, the investment would be liquidated in 413 days.

Another source of loss of compressor efficiency mentioned in the report is radiation from the exposed top steam heads and backs of steam cylinders, which, on account of being hung low on the brackets, or perhaps located on the front end, present large radiating surfaces. It was recommended that compressor top heads and steam cylinders be jacketed all around.

Information of value regarding grinding wheels and their selection was also included in the report which was read by C. B. Miles, C. C. C. & St. L., representing the Pittsburgh Air Brake Club.

Condemning limits of A. R. A. standard triple valve parts

In accordance with the decision of the association at the Montreal convention, the committee on this subject submitted additional recommendations for consideration. Particular attention was called to the fact that shop facilities, gages, tools, etc., required at the time of repairs to triple valves have not kept pace with the improvements common in well-managed shops largely owing to the gradual though rapid increase in volume of this work. The report indicated that the time has now arrived when air brake shops should be provided with more modern appliances in order that repairs may be made to a uniformly high standard. A somewhat radical departure from previous reports was made through the recommendation of certain gages, tools,* etc., which the committee felt would result in economy when repairing triple valves and reduce the number of failures. Realizing the difficulties and expense involved if each railroad independently set about determining the amount of wear and limiting dimensions that should prevail for each of the component parts of triple valves, the committee went thoroughly into this question in conjunction with the triple valve experts of several railroads and with the manufacturers, and made definite recommendations as to the amount of wear allowable and the limiting dimensions. Tools, gages, appliances, etc., necessary or desirable in order to live up to the recommendations were illustrated in the report.

In order to make the report plain, it was divided into four parts, Division A being a key chart of all triple valve parts, Division B showing the limiting dimensions recommended, Division C explaining more in detail the necessity for following these limitations, and Division D showing drawings of tools and appliances mentioned in the report. This report forms an important addition to the literature on triple valve limits of wear and maintenance methods. The report was signed by R. M. Long, P. & L. E.; W. M. Cavin, A. C. L.; M. S. Belk, Southern, and J. R. McClintock, American Brake Company.

Discussion

There was considerable discussion of this report, which was referred to in highly complimentary terms by several members of the association. L. H. Albers, N. Y. C., called attention to the different problems in general confronting roads in the eastern and western sections of the country, these problems being stuck brakes in the former case and undesired quick action or dynamiting in the latter. He felt that the difficulties of the eastern men would be largely solved by improved standards of maintenance if the condemning limits recommended in the

*Drawings of these gages and tools will appear in subsequent issues of the *Railway Mechanical Engineer*.

report for triple valve parts were lived up to. Mr. Albers questioned the advisability of permitting triple valve bushings to be continued in service with wear up to .012 in. as allowed in the report. He recommended thorough service tests with triple valves worn to the maximum diameter in conjunction with the smallest pistons allowable to determine the rate of build up of brake pipe pressure in releasing, feeling that this is the real answer to the problem of stuck brakes.

The undesired quick action obtained on western roads was generally felt to be caused by extreme temperature variations between mountain and desert country expanding the pistons and rings, with the result that they stick in the bushings. This action is very uncertain and erratic, however, and the western representatives felt strongly that there is not sufficient spread between service and emergency applications and that the only remedy is in a heavier graduating spring. Tests are now being conducted under the auspices of the A.R.A. to determine if a heavier spring can be used to increase this spread without diminishing in any way the safety feature.

The members strongly recommended having triple valves repaired by air brake companies or else in a few centralized shops on each road where the high class work necessitated by the limits established in this report can be properly supervised. No work but cleaning and oiling should be permitted at small car repair points and rip tracks.

The report was accepted and the committee discharged with thanks.

Air brake and air signal piping

This report considered in some detail the relative merits of wrought iron and steel tubing for air brake and air signal pipes, the comparison being strongly in favor of the former. A brief explanation was also given of various methods of protecting the pipe, such as galvanizing, by immersion in a bath of molten zinc; sherardizing, by revolving the pipe in a drum containing a zinc powder resembling cement; electro-galvanizing, by the electroplating process; calorizing, by revolving in a drum containing aluminum powder; and leadizing in which the lead coating is obtained by precipitation from lead solution; electro-plating, hot dipping or a combination of the three. The following disadvantages of these processes were noted in the report:

1.—The coatings are thin and not continuous.

2.—Difficulty in some cases in obtaining any, or a good, coating on the inside of long pieces of small pipe.

3.—Precipitated or electro-deposited coatings are always porous.

4.—Lead, tin or copper are of such an electro-chemical character, with respect to iron or steel, that corrosion of any exposed pipe metal is aggravated, and pitting results. This is a serious matter with pipe threads, that are exposed, and the inevitable breaking of the coating due to the use of pipe wrenches.

5.—The most important disadvantage is the impossibility of bending any of these coated pipes without danger of breaking the coating and exposing portions of the pipe metal to corrosion.

The committee advised that the present recommended practice of the association as to piping be continued upon the following premises:

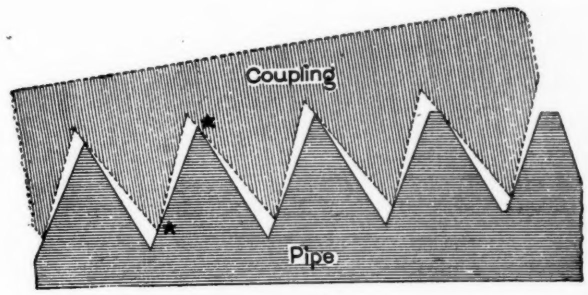
1.—Since the physical characteristics of wrought iron as compared with steel make it much more suitable for use under constant vibration with moisture-laden air, and it is now available in the open market, it should unquestionably be our standard.

2.—As no coating has been developed which will insure protection against corrosion, and at the same time permit of bending pipe, as is essential in air brake work, without danger of rupturing the coating and causing it to flake off and become troublesome in the system, we are opposed to the use of any of these coated pipes.

3.—As the production of wrought iron pipe is small as yet compared with that of steel pipe, the cost of the former must be somewhat greater than that of the latter, but in our judgment it is money well spent, and will be amply repaid in reduced maintenance and much longer life. Furthermore, we do not believe that the additional cost of coated pipes will be repaid in the service rendered by these coatings, while on the other hand, they will unquestionably increase the cost of maintenance.

A proposed change in the recommended practice was also advocated in order to protect against inferior grades of wrought iron. It was suggested that with good wrought iron pipe the standard weight would be sufficient instead of using the extra heavy pipe.

In closing the report the committee called attention to the frequent inconsistency between the threading of pipes and the tapping of sleeve couplings. The recommendation was made that action be taken by the association in order that all fittings for air brake use be tapped on the same tapper as that used for threading the pipes so that contact between the threads will be continuous. Such fittings were said to be available. The committee approved the new "Reinforced" pipe fittings now being introduced for use in railroad service by the air brake manufacturers.



Exaggerated view of fit obtained when a straight-tapped coupling is screwed on a taper-threaded pipe. Stars indicate the only two points of contact between the threads. Tightening the joint mashes the tips of the threads

This report was signed by J. W. Walker, Penna.; W. W. Shriver, B. & O., and F. H. Parke, Westinghouse Air Brake Company.

Discussion

The association was practically unanimous in favor of wrought iron pipe for air brake and air signal piping and voted to adopt as recommended practice the use of uncoated wrought iron pipe made according to A. R. A. or A. S. T. M. specifications for wrought iron. There was a difference of opinion regarding the necessity for using extra heavy pipe on all classes of cars, but most of the members favored its use in connection on locomotive air brake pipes.

A representative of the steel companies stated that all the wrought iron needed can now be obtained on 10 to 20 days delivery and that the reason it is somewhat higher in price than steel pipe results from the fact that it must be hand puddled.

Several members emphasized the necessity of greater care in bending and particularly threading pipe at locomotive and car repair points. Chasers must be kept sharp and compound used to assure smooth, accurately cut threads, the condition of which is an important factor in brake system leakage. The futility of expecting one set of chasers to cut several sizes of threads accurately was pointed out. The use of taper threads on pipe and both male and female pipe fittings was recommended by some of the members.

General News

William H. Johnson, president of the International Association of Machinists, has been re-elected to that office, as appears from the report of the election canvassed at the headquarters of the association in Washington, D. C., on June 1. E. C. Davidson was re-elected secretary-treasurer, and Fred Hewitt editor of the Machinists' Journal.

B. & O. co-operative plan to give shopmen an extra month's work in 1925

Shop employees of the Baltimore & Ohio have earned for themselves about a month's extra work in 1925, according to Vice-president Galloway, as reported in the Baltimore & Ohio Magazine. The plan of co-operation with employees in the shops stipulates that in return for additional endeavor by the employees, the management undertakes to see to it that they are adequately rewarded. This they are trying to do, in the first place, by providing more stable employment. In 1924 heavy improvement work on cars and locomotives, ordinarily not done in the company's own shops, was diverted to them for this purpose. The labor cost on this extra work totaled $347,303. This was not sufficient to provide a full year of 48-hour-week work, but it ameliorated conditions considerably and now, for 1925, the company is planning to do extra work with a labor cost of $2,772,316 in its own shops. This sum amounts to about the same as the average monthly labor expense on maintenance of equipment—hence the statement that the employees are to secure an extra month's work by way of recognition of the benefit to the company of their co-operative efforts.

Up to March 4 the company had received 9,277 suggestions for improvements from employees under the co-operative plan—77.8 per cent of which had been put into effect.

Pennsylvania railroad apprentice school

With the completion of new and enlarged facilities, the scope of the Pennsylvania's apprentice school at Altoona, Pa., has been materially increased, so that approximately 400 apprentices are receiving the benefit of its courses of instruction. The school, which was temporarily discontinued in 1921, was reopened in January of the present year, but was confined to apprentices from the Altoona machine shop only. More room has since been provided by an extension of the building, and in addition to the machine shop boys, the school is now open to regular apprentices from the Juniata shop, the Altoona car shop, the South Altoona foundry, and the Middle Division.

School sessions are held after working hours from 7:00 to 8:30, and 8:30 to 10:00 p. m. on Monday, Tuesday and Wednesday, and from 4:30 to 6:00, 7:00 to 8:30, and 8:30 to 10:00 p. m. on Thursday and Friday, the boys being arranged in sections so that each will be given three hours' school work each week during the period of his apprenticeship. The curriculum provides for mechanical drawing, mathematics and mechanics bearing on shop work, study of materials of construction which deal with the manufacture of iron and steel, and characteristics of different kinds of steel as used in the shop. The courses are adapted for the apprentices in the trades of the different crafts, such as machinists, boilermakers, pipe fitters, and electricians.

Harriman memorial medals to be awarded

The E. H. Harriman Memorial Medals for the best record in accident prevention among American railroads will be awarded this year for the first time since 1916, according to Arthur Williams, president of the American Museum of Safety, New York. In making this announcement Mr. Williams said that analysis of Interstate Commerce Commission statistics indicates that there were fewer casualties among passengers and employees in railroad accidents during 1924 than during any of the preceding nine years. "Mrs. E. H. Harriman has authorized the resumption of the E. H. Harriman Memorial Medals for the year ending December 31, 1924," Mr. Williams said.

The Harriman Gold Medal will be given to the railroad which has the best record for accident prevention and health promotion throughout the system as a whole; a replica in silver will be awarded to the division of the road which has the best individual safety record; and a replica in bronze will be presented to the

Passenger cars installed and retired

Quarter	No. installed during quarter	No. retired from service during quarter	No. owned or leased at end of quarter
Full year, 1923	2,719	2,713	......
1924			
Jan.-March	699	431	54,519
April-June	698	552	54,668
July-September	668	544	54,783
Oct.-December	759	849	54,787
Full year, 1924	2,824	2,376	......
1925			
Jan.-March	609	589	54.594

Figures in remaining columns from Car Service Division, A. R. A. quarterly report of passenger cars, Form C. S. 55 A. Figures cover only Class I roads reporting to Car Service Division.

Locomotives installed and retired

Month—1924	Installed during month	Aggregate tractive effort	Retired during month	Aggregate tractive effort	Owned at end of month	Aggregate tractive effort	Building in R. R. shops
January	271	15,228,895	178	4,447,721	64,989	2,552,694,953	14
February	214	11,296,088	175	4,906,435	65,029	2,559,519,253	10
March	176	10,457,064	181	6,033,173	64,911	2,560,076,766	7
April	97	4,167,388	112	2,881,385	64,896	2,561,362,769	11
May	153	6,949,353	107	2,600,445	64,942	2,565,706,413	10
June	160	7,687,383	178	4,575,358	64,924	2,569,121,875	72
July	197	10,590,558	113	3,354,456	65,008	2,576,433,377	63
August	229	12,513,395	166	5,346,176	65,062	2,583,372,980	50
September	160	7,061,560	151	4,351,378	65,071	2,586,083,994	37
October	113	5,743,775	220	5,712,633	64,964	2,586,106,026	76
November	181	8,460,795	263	7,749,794	64,882	2,586,826,278	70
December	295	12,311,451	304	9,724,426	64,871	2,589,358,971	64
Total for year 1924	2,246	....	2,148	....	.....	....	..
January, 1925	167	7,455,971	213	6,242,079	64,824	2,590,525,478	81
February	125	6,233,494	169	5,118,878	64,779	2,591,618,849	77
March	138	6,249,721	170	4,888,933	64,747	2,592,979,637	83
April	171	7,498,252	409	13,126,135	64,509	2,587,347,354	82
May	147	7,930,840	172	5,329,461	64,484	2,589,912,779	80

Figures as to installations and retirements prepared by Car Service Division, A. R. A., published in Form C. S. 56A-1. Figures cover only those roads reporting to the Car Service Division. Figures of installations and retirements alike include equipment rebuilt to an extent sufficiently so that under the accounting rules it must be retired and entered in the equipment statement as new equipment.

employee who, in the judgment of the road, has been most conspicuous in furthering accident prevention. The awards will be made by the following committee:

R. H. Aishton, President, American Railway Association.
Samuel O. Dunn, Editor, Railway Age.
John Jacob Esch, Interstate Commerce Commissioner.
Julius H. Parmelee, Director, Bureau of Railway Economics.
Arthur Williams, Chairman.

The conditions under which the awards will be made, which were worked out under the direction of Julius Kruttschnitt, include a table of weights providing a penalty fifty times as great for fatal accidents as for non-fatal. Railroads are required to report accidents in and around shops, on boats or wharves, at stations, freight houses, engine houses, coaling stations, water stations, and accidents which occur in connection with construction, repair, painting, and maintenance of equipment, as well as train accidents and train service accidents.

Copies of the conditions of competition and of the forms on which the accident data are to be submitted have been sent to the president of every Class I steam railroad in the United States. The award will be based on the accident experience of railroads during the calendar year of 1924.

Meetings and Conventions

The International Railway Supply Men's Association, during the exhibition held in connection with the International Railway Fuel Association Convention at Hotel Sherman, Chicago, May 26 to 29, elected the following officers: president, Bard Brown, Superheater Company, New York; vice-president, F. S. Wilcoxen, Edna Brass Manufacturing Company, Chicago; treasurer, W. H. Harris of the W. H. Harris Coal Company, Chicago; secretary, F. P. Roesch, Standard Stoker Company, Chicago. Members elected to the executive committee were M. K. Tate, Lima Locomotive Works, Lima, Ohio, L. G. Plant, National Boiler Washing Company, Chicago, W. H. Heckman, Harry Vissering & Co., Chicago, and C. O. Jenista, Barco Manufacturing Company, Chicago.

Great Northern to hold stores convention

The Great Northern held a system convention of stores officers at Superior, Wis., on June 19 and 20. This was the second annual meeting of the system store organization, which was inaugurated last year. Sessions were held in the Hotel Amboy, under the direction of the president, Howard Hayes, general storekeeper, and a general committee. Reports of committees and papers were presented on the following subjects: Scrap handling and reclamation; handling of building and bridge work sheets; developments at the annual meeting of Division VI, A. R. A.; short cuts and methods in store department accounting; handling and storing lumber; fire protection; mechanical appliances; beautifying store grounds; controlling and distributing store stock and the inspection and testing of material.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs.

AIR BRAKE ASSOCIATION.—F. M. Nellis, Room 3014, 165 Broadway, New York City.

AMERICAN RAILROAD MASTER TINNERS', COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.—C. Borcherdt, 202 North Hamlin Ave., Chicago.

AMERICAN RAILWAY ASSOCIATION, DIVISION V.—MECHANICAL.—V. R. Hawthorne, 431 South Dearborn St., Chicago.

DIVISION V.—EQUIPMENT PAINTING SECTION.—V. R. Hawthorne, Chicago. Next meeting September, 1925.

DIVISION VI.—PURCHASES AND STORES.—W. J. Farrell, 30 Vesey St., New York.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—G. G. Macina, 11402 Calumet Ave., Chicago. Annual convention September 2-4, Hotel Sherman, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division. A. F. Steubing, Bradford Corp., 25 West Forty-third Street, New York.

AMERICAN SOCIETY FOR STEEL TREATING.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio. Annual convention week of September 14, 1925, Cleveland, Ohio.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill. Annual meeting October 27 to 30, inclusive, Hotel Sherman, Chicago.

CANADIAN RAILWAY CLUB.—C. R. Crook, 129 Charron St., Montreal, Que. Regular meetings second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill.

CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—R. E. Giger, 721 North 23rd street, E. St. Louis, Ill. Meetings, first Tuesday in month, except June, July and August, at the American Hotel Annex, St. Louis.

CAR FOREMEN'S CLUB OF LOS ANGELES.—J. W. Krause, 514 East Eighth street, Los Angeles, Cal. Meeting second Friday of each month in the Pacific Electric Club Building.

CENTRAL RAILWAY CLUB.—H. D. Vought, 26 Cortlandt Street, New York, N. Y. Regular meetings second Thursday each month, Hotel Statler, Buffalo, N. Y.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—A. S. Sternberg, Belt Railway, Clearing Station, Chicago. Annual convention Hotel Sherman, Chicago, September 22-24.

CINCINNATI RAILWAY CLUB.—W. C. Cooder, Union Central Building, Cincinnati, Ohio. Meetings second Tuesday, February, May, September and November.

CLEVELAND STEAM RAILWAY CLUB.—F. L. Frericks, 14416 Adler Ave., Cleveland, Ohio. Meeting first Monday each month except July, August and September, at Hotel Cleveland, Public Square, Cleveland.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich. Next convention, Hotel Winton, Cleveland, Ohio, August 18, 19 and 20.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—J. B. Hutchinson, 1809 Capitol Ave., Omaha, Neb.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabasha Ave., Winona, Minn. Annual convention September 8-11, Hotel Sherman, Chicago.

MASTER BOILER MAKERS' ASSOCIATION.—Harry D. Vought, 26 Cortlandt St., New York, N. Y.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meeting second Tuesday in month, except June, July, August and September. Copley-Plaza Hotel, Boston, Mass.

NEW YORK RAILROAD CLUB.—H. D. Vought, 26 Cortlandt St., New York. Meeting third Friday each month, except June, July and August at 29 West Thirty-ninth Street, New York.

NIAGARA FRONTIER CAR MEN'S ASSOCIATION.—George A. J. Hochgreb, 623 Brisbane Building, Buffalo, N. Y. Regular meetings, January, March, May, September and October.

PACIFIC RAILWAY CLUB.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings second Thursday of each month in San Francisco and Oakland, Cal., alternately.

RAILWAY CLUB OF GREENVILLE.—F. D. Castor, clerk, maintenance of way department, Bessemer & Lake Erie, Greenville, Pa. Meeting last Friday of each month, except June, July and August.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August. Fort Pitt Hotel, Pittsburgh, Pa.

ST. LOUIS RAILWAY CLUB.—B. W. Frauenthal, Union Station, St. Louis, Mo. Regular meetings second Friday in each month, except June, July and August.

SOUTHEASTERN CARMEN'S INTERCHANGE ASSOCIATION.—J. E. Rubley, Southern railway shops, Atlanta, Ga.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, 1177 East Ninety-eighth Street, Cleveland, Ohio. Annual meeting September 15-18, 1925, Chicago.

WESTERN RAILWAY CLUB.—Bruce V. Crandall, 189 West Madison Street, Chicago. Regular meetings third Monday in each month, except June, July and August.

Freight cars installed and retired

Month—1924	Installed during month	Aggregate capacity tons	Retired during month	Aggregate capacity tons	Owned at end of month	Aggregate capacity tons	Building in R. R. shops
January	15,589	707,367	12,329	516,695	2,310,032	100,644,107	2,417
February	11,386	554,481	10,466	411,228	2,310,570	100,767,731	2,715
March	9,962	446,094	8,726	352,481	2,311,405	101,165,332	2,697
April	8,718	369,978	8,026	306,288	2,312,074	101,223,891	2,739
May	9,199	439,516	9,059	360,212	2,312,237	101,303,200	2,467
June	10,909	538,118	8,347	321,094	2,314,798	101,569,593	2,269
July	16,583	1,151,302	8,413	316,927	2,322,968	102,388,652	4,602
August	15,452	785,288	8,834	333,173	2,329,582	102,845,000	3,618
September	15,455	779,078	9,337	370,607	2,336,147	103,270,000	3,045
October	16,598	834,762	10,504	*418,816	2,342,149	103,688,000	*3,574
November	11,705	579,234	10,678	463,970	2,342,479	103,767,000	5,159
December	6,763	311,254	11,918	488,035	2,337,229	103,585,000	6,478
January, 1925	11,768	551,263	7,867	326,812	2,341,109	103,812,974	5,285
February	15,024	721,867	9,453	365,111	2,346,687	104,169,525	4,878
March	16,607	753,947	12,067	474,644	2,350,697	104,454,128	5,572
April	13,749	652,462	10,497	423,322	2,353,956	104,683,798	8,072

*Corrected figure.

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Supply Trade Notes

The Forged Steel Wheel Company has moved its office from 170 Broadway to 120 Broadway, New York City.

A. J. Jones, secretary and general manager of the Acme Machine Tool Company, Cincinnati, Ohio, died on May 31.

The Griffin Wheel Company, Chicago, has prepared plans for the construction of an additional plant at Salt Lake City, Utah.

The Hannauer Car Retarder Company, Chicago, has been incorporated to manufacture and sell car retarders and other specialties.

J. M. Davis, president of Manning, Maxwell & Moore, New York, has resigned to become president of the Delaware, Lackawanna & Western.

The Morton Manufacturing Company has appointed the Peden Iron & Steel Company, Houston, Texas, and San Antonio, its southwestern representative.

The Engineering Products Company, Rialto building, San Francisco, Cal., has been appointed Pacific Coast representative of the Clark Car Company, Pittsburgh, Pa.

Emmet K. Conneely, vice-president and manager of sales of the New York Air Brake Company, at New York, has been elected also a member of the board of directors.

The Achuff Railway Supply Company has been incorporated in St. Louis, Mo., to manufacture railway supplies. The incorporators are J. B. Black and W. D. Achuff.

W. C. Miner, general sales manager of the Railway Service & Supply Corporation, has removed his headquarters to Indianapolis, Ind., and the Chicago office has been closed.

Marshall A. Carlton has been appointed Baltimore representative of the Verona Tool Works, Pittsburgh, Pa., with headquarters in the Munsey building, Baltimore, Md.

The Crane Company, Chicago, has acquired property on India street, San Diego, Cal., and contemplates the erection of a factory branch and distributing plant to cost about $80,000.

George T. Willard, representative of the Rail Joint Company, has resigned to become a sales representative of the Railroad Supply Company. His headquarters will be in Chicago.

John A. Zupez has been appointed mechanical engineer of the More-Jones Brass & Metal Company, St. Louis, Mo. Mr. Zupez was formerly in the general mechanical engineer's office of the Missouri Pacific.

E. M. McLean, sales division manager of the Four Wheel Drive Auto Company, Clintonville, Wis., has been promoted to general sales manager. S. H. Sanford, formerly sales division manager, is now assistant sales manager.

Thomas O'Leary, Jr., formerly with the New York Air Brake Company, is now a special representative of the general railroad department, Johns-Manville, Inc., with headquarters at 409 Dooly Block, Salt Lake City, Utah.

Francis W. Pratt, assistant to president of the Goodell-Pratt Company, Greenfield, Mass., has been appointed sales manager to succeed Oscar W. Bardwell, who has resigned as general sales manager but who still remains a director of the company.

Woodson H. Hudson, vice-president of the Georgia Car & Locomotive Company, Atlanta, Ga., died on May 27 in Atlanta at the age of 64. Mr. Hudson for a number of years was connected with the Southern Railway in the motive power department.

The complete line of Garvin tapping machines formerly built by the Garvin Machine Company, New York, has been purchased by the Western Machine Tool Works, Holland, Mich. The Western Machine Tool Works will build a complete line of taper roller bearing equipped tapping machines.

Gunner R. Lundane, formerly manager of the New York office of the Black & Decker Manufacturing Company, has resigned to join the United States Electrical Tool Company, Cincinnati, Ohio, as special eastern representative. He will have his headquarters at the company's office, 50 Church street, New York City.

The New York district sales office of the Consolidated Machine Tool Corporation of America has been removed to 150 Broadway. The Betts Works, Colburn Works and Newton Works of the company are now located at Rochester, N. Y.; the Hilles & Jones Works, at Wilmington, Del., and the Modern Works, at Erie, Pa.

The Locomotive Stoker Company has acquired from the Elvin Mechanical Stoker Company the exclusive patent rights covering the Elvin shovel type stokers heretofore sold by that company, and with their ample facilities for manufacturing stoker equipment for locomotives they are now in a position to supply either the duplex or the shovel type as may be preferred.

The Hammond Brass Works, Hammond, Ind., manufacturers of brass valves and specialties, has placed a contract with the Austin Company, Chicago, for the design and construction of a new foundry and machine shop on Summer street. The new building is to be a 90-ft. by 300-ft. one-story steel structure, containing approximately 30,000 sq. ft. of floor space.

G. H. Webb has been appointed Philadelphia sales manager of the Central Steel Company, Massillon, Ohio. He succeeds A. B. Cooper who died at his home in Philadelphia on May 3. Mr. Webb had been identified with the Central Steel Company for more than eleven years. A branch office of the Central Steel Company has been opened at Los Angeles, Cal.

The Impact Register Company, Inc., Champaign, Ill., of which W. S. Redhed is president and treasurer, H. B. Morrow, vice-president, and L. A. Busch, secretary, has acquired from the Savage Impact Register Company the exclusive rights to manufacture and sell the Savage impact register for the measurement of impact in cars and elsewhere, and Edwin W. Savage has retired from active connection with the sale of this device.

The Safety Car Heating & Lighting Company, New York, has entered into an agreement with the Silica Gel Corporation, Baltimore, Md., for the development under exclusive license, of apparatus for use by railroads and other transportation refrigeration generally. The Safety Car Heating & Lighting Company's engineers, after investigation have decided that the use of Silica Gel for refrigeration is sound and gives promise of extended use.

J. W. Hubbard, of Pittsburgh, Pa., has purchased the controlling interest in the Detroit Seamless Steel Tubes Company, Detroit, Mich., and has been elected chairman of the board of directors. A. A. Templeton, formerly president and general manager, having disposed of his interest in the company, has been succeeded by C. H. Hobbs, who has been vice-president since January, 1922. There will be no other changes in the officers of the company or in the general policies under which it operates.

The Cleveland Punch & Shear Works Company, Cleveland, Ohio, has completed a plant extension program, including the addition of considerable new equipment that will result in an increase of about 50 per cent in its capacity. Robert J. Pardee has been appointed vice-president and works manager, and Arthur Schloz, press engineer. Both were formerly connected with the Toledo Machine & Tool Company, Toledo, Ohio, for about 15 years, Mr. Pardee as assistant to the president and Mr. Schloz as head designer.

J. R. McGinley has been elected chairman of the board of directors of the Duff Manufacturing Company, Pittsburgh, Pa., and is succeeded as president by Thomas A. McGinley. C. N. Thulin has been appointed vice-president in charge of the western sales division, having jurisdiction over the company's main offices and representatives in the middle west, south west, mountain states and Pacific coast. His headquarters, as heretofore, will be in the Peoples Gas building, Chicago. P. G. O'Hara has been appointed vice-president in charge of the eastern sales division which comprises the eastern, central and southern district offices. Mr. O'Hara's headquarters will be at 250 Park avenue, New York City.

The Niles-Bement-Pond Company and the Pratt & Whitney Company, which hitherto maintained joint general sales and accounting departments at New York, have recently moved the sales and accounting departments to the plants. That of the

Niles-Bement-Pond Company is at Hamilton, Ohio, and the Pratt & Whitney Company, at Hartford, Conn. The general executive offices of the two companies remain as formerly at New York; E. L. Leeds, general sales manager, has been appointed vice-president in charge of sales of both companies, with headquarters at New York; Harold F. Welch, New York district sales manager, has been appointed general sales manager of the Niles-Bement-Pond Company, with headquarters at Hamilton; W. P. Kirk, assistant general sales manager of the two companies, has been made general sales manager of the Pratt & Whitney Company; C. K. Seymour, secretary of both companies, is also vice-president, succeeding C. L. Cornell, resigned; Arlo Wilson, special accountant, has been appointed also assistant treasurer to succeed Walter R. Boom, resigned; E. L. Morgan, chief accountant of the Pratt & Whitney Company at New York, has been transferred to the Hartford office; W. L. Burk, Jr., chief accountant of the Niles-Bement-Pond Company, has been transferred from the New York office to Hamilton, and George G. Greist, general manager of the Niles Tool Works, Hamilton, has been made general manager of the Niles-Bement-Pond Company, in charge of the Hamilton office.

Charles A. Starbuck, president of the New York Air Brake Company, died on May 29 at his home in Croton-on-Hudson, N. Y. Mr. Starbuck was born in Niagara County, N. Y., on September 17, 1852, and was educated in the public schools of his native county. He went to New York in 1870 and first worked in the office of a diamond merchant. He afterwards entered the brake business and became vice-president of the Eames Vacuum Brake Company. In 1890 he was elected secretary of the New York Air Brake Company, the successor of the Eames Vacuum Brake Company, the following year he became vice-president and in 1895 was elected president. Under his administration the business of the company expanded to its present large proportions in its field.

C. A. Starbuck

The board of directors of the Standard Tank Car Company has been reconstituted in accordance with a plan of readjustment adopted last February. The board as now constituted consists of: James Andrews, vice-president and general manager; Walter P. Chrysler, chairman of the board of the Maxwell Motor Corporation; William F. Cutler, president of the Southern Wheel Company; Duncan A. Holmes, vice-president of the Chase Securities Company; Stewart McDonald, president of the Moon Motor Car Company; Grayson M. P. Murphy, chairman of the board; J. B. Orr, president; Samuel F. Pryor, chairman of the executive committee, Remington Arms Company; and Ernest Stauffen, Jr., vice-president of the New York Trust Company.

The company's operating organization at Sharon, Pa., has been strengthened by the election of James Andrews as vice-president and general manager, and of Harry Graham as vice-president in charge of sales and operation. Mr. Graham was formerly vice-president in charge of sales of the Illinois Car & Manufacturing Company at Chicago. Substantial progress has been made by the company in the matter of new business and on June 1, the company opened an office at Tulsa, Okla., with F. S. Thompson in charge. In connection with the recent sale by the company of $4,250,000 of National Steel Car Line's equipment trust certificates, the Standard Transit Company was organized to take over the tank line business and the 2,757 tank cars formerly operated by the Tank Car Company, which are leased principally to the large oil companies. The directors of the Standard Tank Car Company will also serve as directors of the Standard Transit Company. The Standard Tank Car Company has an office at Sharon, Pa., and its plant is located at Masury, Ohio, 12 miles from Youngstown.

Trade Publications

WELDING AND CUTTING APPARATUS.—The Alexander Milburn Company, Baltimore, Md., has issued a 26-page brochure descriptive of the Milburn welding and cutting apparatus.

GEARS.—Catalogue No. 46, embodying many recent additions to the list of standardized Boston gears, has been issued by the Boston Gear Works, Inc., Norfolk Downs (Quincy), Mass.

THREADING MACHINES.—"Thread with Landis" is the title of a 12-page illustrated booklet which has recently been issued by the Landis Machine Company, Waynesboro, Pa., descriptive of Land-Matic die heads.

YOKE RIVETERS.—Bulletin R-205 descriptive of Hanna yoke riveters, which range in sizes from 4 in. to 21 ft. reach and in capacities from 6 tons to 150 tons, has been issued by the Hanna Engineering Works, Chicago.

CRANES.—Bulletin No. 36, illustrating and describing Type V cranes for mounting on motor truck chassis, road wheels, flexible crawling treads or rail wheels, has been issued by the Orton & Steinbrenner Company, Chicago.

AIR-TIGHT DOOR.—The American air-tight door for ash pits, boiler settings and other locations where an air-tight door is needed, is described in a four-page folder issued by the Conveyors Corporation of America, Chicago.

VISES.—Catalogue No. 57-B listing discontinued Parker vises and illustrating their substitutes, has been issued by the Charles Parker Company, Meriden, Conn. Line drawings illustrate the various parts of Parker vises, and the names used to designate these parts are given.

VERTICAL SURFACE GRINDER.—Complete description and specifications of the Blanchard high power vertical surface grinder are contained in catalogue No. 16, which has just been issued by the Blanchard Machine Company, Cambridge, Mass. The description is paralleled on the left-hand pages, with large illustrations and production data of a variety of work done on the machine.

PACKINGS.—Catalogue A-1925 outlining the features of Garlock service and describing and illustrating its general line of packings—asbestos, rubber, metal and fibrous—gaskets, pump valves, valve discs, etc., has been issued by the Garlock Packing Company, Palmyra, N. Y. Colored illustrations are interspersed throughout the 176 pages of this catalogue, which is attractively bound in black leather.

ARC WELDING.—A resumé of the uses and value of automatic arc welding, together with a description of the welding apparatus and generating equipment used, is given in Bulletin No. 48937.1 entitled "Automatic Arc Welding," which has recently been issued by the General Electric Company, Schenectady, N. Y. This paper bound booklet contains 20 pages and is well illustrated by photographs of equipment and actual applications.

"FORTY YEARS OF PROGRESS."—This is the title of a 64-page book issued by the Harnischfeger Corporation, Milwaukee, Wis., in which a concise history of its growth and development since its founding forty years ago, and photographs and descriptions of the entire plant and personnel as it is today are given. Each of the various products in the electric crane, hoist, machine tool and gasoline excavator lines, are also illustrated and described.

BRAKE BEAMS AND SUPPORTS.—A loose-leaf catalogue containing 75, 6-in. by 9-in. pages of mechanical drawings of "Creco" equipment has been issued recently by the Chicago Railway Equipment Company, Chicago. The drawings presented have been selected to show the standards of the various types of brake beams, side bearings and "Creco" third and fourth point brake beam supports and safety devices manufactured by this company. The drawings and information contained in this catalogue are presented in an attractive form and logical sequence, the catalogue being intended as an aid in making satisfactory selections of equipment to meet all requirements and conditions of service. Brake beam repair parts can be ordered by numbers shown on spare part charts or by pattern numbers shown in the main body of the catalogue.

Personal Mention

General

A. O. GERTZ has been appointed motive power inspector of the Eastern Pennsylvania division of the Pennsylvania.

D. L. B. FRINGER has been appointed motive power inspector of the Central Pennsylvania division of the Pennsylvania.

HENRY P. HASS, special assistant to the mechanical manager of the New York, New Haven & Hartford, has been appointed assistant to the mechanical manager. Mr. Hass is a graduate of Sheffield Scientific School, Yale University, of the class of 1907. He began railroad work on July 1, 1907, when he entered the service of the New York, New Haven & Hartford as a special apprentice. Two years later he was appointed material inspector and on December 1, 1911, he became chief material inspector. On February 1, 1916, he was appointed engineer of tests, which position he held until his appointment as office assistant to the mechanical manager on December 1, 1923.


Henry P. Hass

J. H. REISSE has been appointed mechanical inspector of the Chicago, Burlington & Quincy, with headquarters at Chicago.

T. B. FARRINGTON has been transferred to Chicago as assistant general superintendent of motive power of the new Western region.

FRANK E. BALLDA, assistant to the mechanical manager of the New York, New Haven & Hartford, has been appointed mechanical superintendent, Lines East, with headquarters at Boston, Mass., succeeding B. A. Moriarty. Mr. Ballda began his railroad service as a machinist apprentice with the New York, West Shore & Buffalo (New York Central) in 1885. In November, 1889, he went to the Erie as a machinist and in January, 1890, to the New York, Chicago & St. Louis in the same capacity. Three months later he returned to the West Shore as a machinist and a year later was promoted to foreman. In May, 1896, he went to the Fitchburg as foreman. In 1897 he became a machinist for the New York, New Haven & Hartford, and the following year was promoted to roundhouse foreman. In March, 1904, he became assistant general foreman and in March, 1908, general foreman. In March, 1912, he was promoted to master mechanic and in May, 1915, to superintendent of shops at New Haven. In September, 1918, he became superintendent of shops at Readville, and in August, 1923, assistant to the general mechanical superintendent. In December, 1923, he was appointed assistant to the mechanical manager.


Frank E. Ballda

FRANK H. BECHERER has been appointed assistant to the mechanical superintendent of the Boston & Maine, with headquarters at Boston, Mass., succeeding Daniel A. Smith, who has been assigned to other duties.

A. C. Davis, formerly assistant chief of motive power—locomotive—has been transferred to Altoona, Pa., as assistant works manager, succeeding T. B. Farrington.

GEORGE A. MORIARTY, mechanical superintendent of the New York, New Haven & Hartford, at Boston, Mass., has been appointed general mechanical superintendent, with headquarters at New Haven, Conn. Mr. Moriarty began his railroad career in 1887, when he started as a machinist apprentice on the Baltimore & Ohio. In March, 1891, he went to the Pittsburgh, Cincinnati, Chicago & St. Louis (Pennsylvania) as a machinist and served in this capacity subsequently with the Baltimore & Ohio, the Louisville & Nashville, the McNamar Machine Company, the Cincinnati, New Orleans & Texas Pacific, Jeffreys Machine Company, again with the Baltimore & Ohio, the Cleveland, Cincinnati, Chicago & St. Louis and the Columbus Machine Works. In September, 1895, he returned to the Baltimore & Ohio as machine shop foreman. In September, 1898, he again left that railroad, returning in July, 1899, as assistant roundhouse foreman. In February, 1901, he was promoted to roundhouse foreman and continued in that capacity until June, 1903, when he went to the Erie in a similar capacity. In 1904, he was promoted to general foreman and in October, 1906, to master mechanic. In 1907, he went to the New York, New Haven & Hartford as master mechanic, was promoted in January, 1917, to general master mechanic, Eastern grand division, and four months later to mechanical superintendent, Lines East.


G. A. Moriarty

WILLIAM L. BEAN, assistant mechanical manager of the New York, New Haven & Hartford, with headquarters at New Haven, Conn., has been promoted to mechanical manager with the same headquarters, succeeding L. M. Reed, resigned. Mr. Bean was born on January 3, 1878, and was graduated from the University of Minnesota in 1902, having completed a course in mechanical engineering. He immediately entered the service of the Northern Pacific as a special apprentice, and served in that capacity until late in 1904. On January 1, 1905, he became gang foreman of the Atchison, Topeka & Santa Fe. The following year he was promoted to inspector, and in 1908 to machine shop foreman. In 1909 he became division foreman, and a few months later, motive power assistant. In 1911, he was appointed bonus supervisor and held that position until early in 1912. He then entered the service of the Oxweld Railroad Service Company as chief engineer, remaining with that company until 1916. Mr. Bean went with the New Haven in July, 1916, and in September, 1917, was made assistant general mechanical superintendent, and on November 1, 1918, mechanical assistant to the president, acting in that capacity until December 1, 1923, at which time he was made assistant mechanical manager. His final work was that of assisting the president in his investigation of the property and in


W. L. Bean

formulating a report and recommendations in accordance with which a program for the improvement of the property was undertaken. Mr. Bean in particular covered matters relating to mechanical department facilities, new power, etc. Subsequently it has been largely in accordance with his recommendations and plans that the very large number of improvements for affording the mechanical department better facilities have been carried out and the large purchases of new locomotives have been made.

Kenneth Cartwright has been appointed assistant mechanical engineer in charge of specifications, designs, records and standards of equipment of the New York, New Haven & Hartford. Mr. Cartwright was graduated from the Massachusetts Institute of Technology as a mechanical engineer in 1912. He began his railroad career as a material inspector for the New Haven in June, 1914. In June, 1918, he left the railroad to become a junior lieutenant in the Navy. He returned to the railroad in February, 1920, as assistant to the engineer of tests and general mechanical inspector. On May 16, 1924, he was appointed chief mechanical inspector, which position he held until his recent appointment.

Pennsylvania combines two regions

On June 1 the operations of the Pennsylvania in the Northwestern and Southwestern regions of the system were combined for the purpose of obtaining the advantages of a more concentrated administration of the service and the facilities in the territory affected. The consolidated region is known as the Western region.

R. G. Bennett, who recently was appointed general superintendent of motive power, Southwestern region, is now general superintendent of motive power, Eastern region, with headquarters at Philadelphia, Pa.

J. M. Henry has been appointed assistant chief of motive power —locomotives—on the staff of the chief of motive power of the Pennsylvania system. Mr. Henry was born on October 10, 1873, at Altoona, Pa. He entered the service of the Pennsylvania as a special apprentice in the Altoona machine shops in May, 1889, and served as an apprentice until September 1, 1896, when he entered Purdue University, being furloughed from the shops during the school term each year. He was graduated in June, 1900, and then became a special apprentice in the office of the assistant engineer of motive power at Altoona. A year later he was promoted to motive power inspector at Altoona, and in February, 1902, became assistant engineer of motive power of the Erie division and Northern Central Railway at Williamsport, Pa. From July 1, 1903, to December, 1913, he was master mechanic at various shops. On the latter date he was promoted to superintendent of motive power of the Western Pennsylvania division, and on May 1, 1916, was transferred to the operating department as assistant superintendent of the Pittsburgh division. In April, 1917, he was transferred to the New York division, and in October of the same year he was appointed assistant general superintendent of motive power at Altoona. On March 1, 1920, he was appointed one of the four regional general superintendents of motive power, which position he held until his recent promotion.

J. M. Henry

F. L. Carson, mechanical superintendent of the San Antonio & Aransas Pass, has been promoted to assistant superintendent motive power and equipment of the Southern Pacific, lines in Texas, with headquarters at Yoakum, Tex. Mr. Carson was born on February 23, 1871, at Oakland, Cal. He entered railway service in 1890 as an apprentice in the mechanical department of the Atchison, Topeka & Santa Fe and was promoted to erecting foreman in 1895. He was promoted to roundhouse foreman in 1897 and to general foreman at Cleburne, Tex., in 1900. Mr. Carson was promoted to master mechanic of the Northern division in 1901, where he remained until 1905, when he was appointed master mechanic of the El Paso & Southwestern, now a part of the Southern Pacific. Two years later he was appointed master mechanic of the Mexican Central, where he remained until 1909, when he resigned to become superintendent of machinery of a mining company. Mr. Carson returned to railway service in 1912 as master mechanic of the Chicago Great Western. Later in that year he was appointed master mechanic of the San Antonio & Aransas Pass, with headquarters at Yoakum, Tex., in which position he remained until November, 1914, when he was promoted to superintendent of motive power. His recent appointment as assistant superintendent of motive power and equipment of the Southern Pacific, lines in Texas, is the result of the consolidation of the San Antonio & Aransas Pass with the Southern Pacific lines.

A. McDonald has been appointed acting superintendent of motive power of the shops of the Canadian National at Montreal, Que., succeeding G. M. Wilson, who has been assigned to other duties.

J. T. Carroll, general superintendent motive power of the Baltimore & Ohio at Baltimore, Md., has been appointed general superintendent motive power and equipment, with the same headquarters.

Car Department

R. Price has been appointed car foreman of the Black Hills division of the Chicago & Northwestern, with headquarters at Chadron, Neb., succeeding E. R. Phillips.

J. J. Tatum, superintendent car department of the Baltimore & Ohio at Baltimore, Md., has been appointed general superintendent car department, with the same headquarters.

Master Mechanics and Road Foremen

John T. Grow has been appointed district master car builder of the New York Central, with headquarters at Albany, N. Y., succeeding G. E. Carson, retired. Mr. Grow was born on March 30, 1887, at Buffalo, N. Y., and was later graduated from the Masten Park High School, Buffalo, N. Y. He entered railway service on September 6, 1904, as a laborer in the planing mill of the East Buffalo Car Shops of the New York Central. In 1907, he was promoted to mechanic, and in 1908, to piecework inspector. He became foreman at Corning, N. Y., in 1912, and held this position until 1915, when he was transferred as foreman to Clearfield, Pa. From 1917 to 1923, he was assistant shop superintendent at Avis, Pa., and at that time became assistant district master car builder at Albany, N. Y., which position he held at the time of his recent appointment.

John T. Grow

J. E. Frels, master mechanic of the San Antonio & Aransas Pass, at Yoakum, Tex., has been appointed master mechanic of the Southern Pacific, with the same headquarters.

E. R. Phillips has been appointed general car foreman of the Iowa division of the Chicago & Northwestern, with headquarters at Council Bluffs, Iowa, succeeding H. W. Hanson.

P. L. Laird has been appointed general car foreman of the Madison division of the Chicago & Northwestern, with headquarters at New Butler, Wis., succeeding H. Bentson.

W. H. Stemple has been appointed general car foreman of the Iowa and Minnesota division of the Chicago & Northwestern, with headquarters at Belle Plaine, Iowa, succeeding R. Price.

H. Bentson has been appointed general car foreman of the

Wisconsin division of the Chicago & Northwestern, with headquarters at (Chase Yards) Allis, Wis., succeeding J. C. Byrne.

H. W. Hanson has been appointed district master car builder of the Iowa and Minnesota, Northern Iowa and Sioux City divisions of the Chicago & Northwestern, with headquarters at Boone, Iowa.

C. C. Nash has been appointed district master car builder of the Madison, Minnesota and Dakota divisions of the Chicago & Northwestern, with headquarters at Winona, Minn., succeeding H. Marsh.

J. W. Dunning has been promoted to general foreman car repairs of the Southern, with headquarters at Columbia, S. C. It was incorrectly stated in the May issue of the *Railway Mechanical Engineer*, under the shop and enginehouse personals, that G. W. Dunning had been promoted to general foreman of the Southern.

Shop and Enginehouse

C. H. Hartland has been appointed assistant foreman of the boiler shop of the Pennsylvania, with headquarters at Renovo, Pa.

A. C. Reeves, erecting shop foreman of the West locomotive shops of the St. Louis-San Francisco at Springfield, Mo., has been promoted to general foreman, succeeding H. J. Ray.

E. L. Iotte, night roundhouse foreman of the Chicago, Milwaukee & St. Paul at Janesville, Wis., has been promoted to day roundhouse foreman, with headquarters at Madison, Wis.

G. T. Goddard, formerly general electrical foreman in the Burnside shops of the Illinois Central, has been appointed equipment inspector of the Chicago terminal improvement department.

H. R. Seaman, gang foreman of the West locomotive shops of the St. Louis-San Francisco at Springfield, Mo., has been promoted to erecting shop foreman, succeeding A. C. Reeves.

P. J. Colligan, superintendent of motive power of the Second district of the Chicago, Rock Island & Pacific, with headquarters at El Reno, Okla., has been appointed superintendent of shops at Silvis, Ill., succeeding S. W. Mullinix, deceased.

H. J. Ray, general foreman of the West locomotive shops of the St. Louis-San Francisco at Springfield, Mo., has been appointed shop superintendent of the North locomotive shops, succeeding J. W. Surles, who has been granted a leave of absence.

Purchasing and Stores

C. J. Pearce has been appointed division storekeeper of the Shasta division of the Southern Pacific, with headquarters at Dunsmuir, Cal.

W. E. Lefaivre, purchasing agent of the Denver & Rio Grande Western, at Denver, Colo., has been appointed general storekeeper, with the same headquarters.

D. C. Curtis, general storekeeper, lines east, of the Chicago, Milwaukee & St. Paul, at Milwaukee, Wis., has been promoted to chief purchasing officer, with headquarters at Chicago.

G. M. Betterton, chief clerk in the purchasing department of the Southern Pacific at San Francisco, Cal., has been promoted to assistant purchasing agent, with the same headquarters. This is a newly created position.

Obituary

C. A. Wirth, master mechanic on the Northern Pacific, with headquarters at Pasco, Wash., died in that city on June 1.

David W. Ross, formerly purchasing agent and later general superintendent of transportation of the Illinois Central, who left railway service in June, 1905, died in New York on June 10.

George L. Potter, formerly third vice-president of the Baltimore & Ohio, died on May 31 at his home near Baltimore, Md. Mr. Potter was born on December 28, 1856, at Bellefonte, Pa., and entered railway service in 1876 as a machinist apprentice on the Pennsylvania. From 1880 to 1882 he was a machinist for this company at Renovo, Pa., and from the latter date to 1887, assistant master mechanic at Fort Wayne, Ind. From 1887 to 1893 he was master mechanic at the same point, and in the latter year was promoted to superintendent of motive power of the Northwest System, Pennsylvania Lines West. From 1899 to 1901 he was general superintendent of motive power. He was then appointed general manager of the Lines West, but resigned that position a few months thereafter to become general manager of the Baltimore & Ohio. In 1903 he was elected third vice-president of the latter road, and served until 1910, when he resigned.

Warren S. Stone, president of the Brotherhood of Locomotive Engineers and of its various banking, investment and industrial enterprises, died in a hospital at Cleveland, Ohio, on June 12, from an acute attack of Bright's disease. Mr. Stone was born on a farm near Ainsworth, Iowa, on February 1, 1860, and entered railway service in 1879 as a locomotive fireman on the Chicago, Rock Island & Pacific at Eldon, Iowa. Five years later he was promoted to engineman and, in 1903, after having served in this capacity for almost 20 years, he became grand chief engineer of the Brotherhood of Locomotive Engineers. Recently, with the multiplication of the organization's financial and industrial undertakings, a reorganization of the Brotherhood was brought about and Mr. Stone was elected president in general charge of all the union's activities, this leaving the labor activities to a newly elected grand chief engineer.

W. S. Stone

S. W. Mullinix, shop superintendent of the Chicago, Rock Island & Pacific, with headquarters at Silvis, Ill., died on June 12 in Moline, Ill., following a stroke of paralysis. Mr. Mullinix was born in Frederick County, Md., on May 12, 1859. He attended the public schools of Maryland and served an apprenticeship in the shops of the Baltimore & Ohio near Baltimore. Later he became machine shop foreman of the Chesapeake & Ohio at Huntington, W. Va. From Huntington he went to Louisville, Ky., and later to Paducah, Ky., as master mechanic of the Newport News & Mississippi Valley, now a part of the Illinois Central. After a brief period as enginehouse foreman of the Louisville & Nashville, at Louisville, he was appointed general foreman of the Central Vermont, at St. Albans, Vt. In 1903 Mr. Mullinix became master mechanic of the Kansas City Southern; in 1905, master mechanic of the Atchison, Topeka & Santa Fe at Raton, N. M., and in 1906 entered the employ of the Chicago, Rock Island & Pacific. In 1913 he was promoted to superintendent of the Silvis shops, previously having served as district mechanical superintendent at Topeka, Kan.

S. W. Mullinix

H. Englebright, who retired as master car repairer of the Southern Pacific in August, 1922, after a continuous service of 52 years with that road, died on June 5 at his home in Oakland, Cal., at the age of 73. Mr. Englebright entered the service of the old California Pacific as a blacksmith apprentice in 1869 and worked at this trade at various points until 1892, when he was appointed roundhouse and car foreman at Fresno, Cal. In 1898 he became general car foreman at San Francisco and in 1900 master car repairer at Oakland, which position he held until his retirement in 1922.